ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

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SELECTING CONVEYOR BELTS — It's easy to choose the right type of belt and motor size, when you follow this simple guide. p 75

DEEP RUTH — How an alert mining staff adapted block caving methods to changing conditions and solved some perplexing water problems. p 82

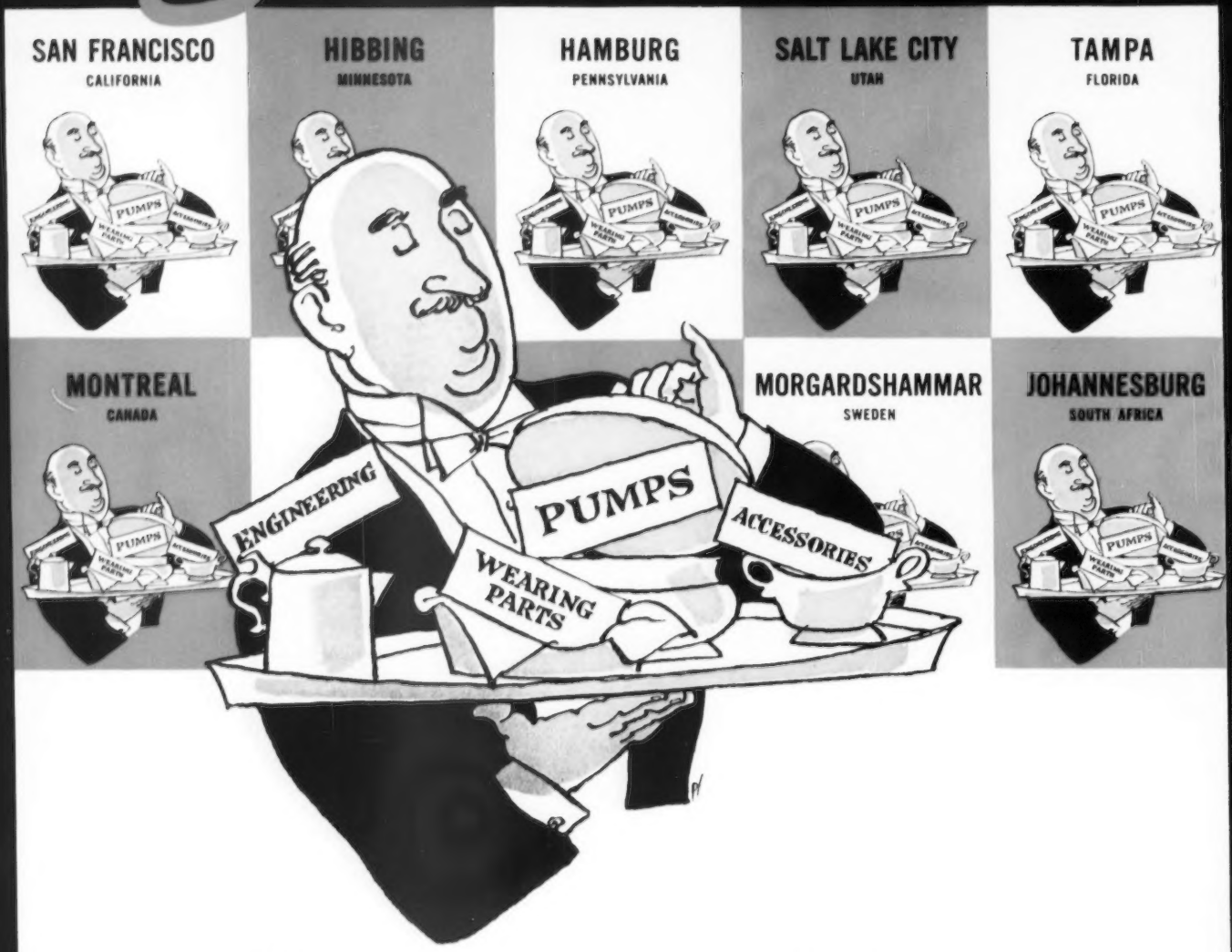
NUCLEAR PRECESSION MAGNETOMETER — Here's the story of how it works and how it can help you in your airborne prospecting. p 88

HOMESTAKE — What the United States' largest gold mine is doing to improve mining and milling in its fight against rising costs. p 91

FLUOSOLIDS — Facts and figures on a roasting technique that permits an African gold mine to treat a highly refractory ore. p 98

SUPER *Service* TO USERS OF PUMPS

IN HANDLING ABRASIVES, CORROSIVES



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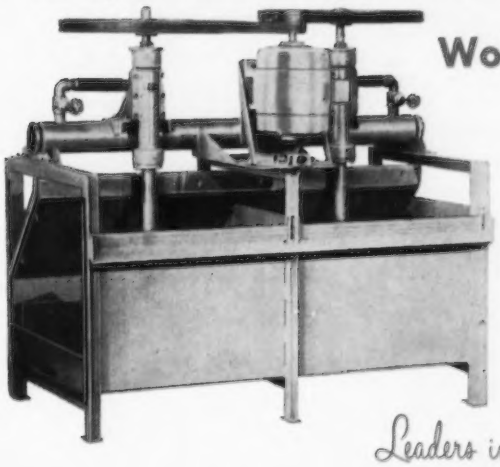

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ENGINEERING AND MINING JOURNAL

91st YEAR OF PUBLICATION

MAY 1957

VOL. 158 NO. 5

FEATURE ARTICLES

How to Select Your Conveyor Belt—Part I ..... **Robert E. Spoerl** 75

Bringing Deep Ruth Into Production ..... **John B. Huttl** 82

How the Nuclear Precession Magnetometer Aids Exploration ..... **James Gimlett, Kenneth E. Hunter, John C. Whitaker** 88

How Homestake Meets Rising Costs 91

How FluoSolids Roasting Aids Gold Recovery at Dalny Mine ..... **Philip Rabone** 98

REGULAR DEPARTMENTS

New Products Digest	35	New Books	105
Editorial	67	New U. S. Patents	106
E&MJ Outlook	68	Personals	108
Markets	69	Operating Ideas	114
This Month in Mining	70	McGraw-Hill Editorial	119
Behind the By-Lines	74	Washington Impact	122

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B.F.Goodrich report:

Rubber turns a mountain inside out

B. F. Goodrich improvements in rubber brought extra savings

Problem: This is part of a 7-mile-long tunnel that will carry billions of gallons of water to a power plant. In digging the tunnel, they've practically turned a mountain inside out.

As fast as dirt and rocks (some of them boulders weighing 3000 pounds each) are blasted out, they're dumped on a rubber belt and carried away. But the smashing blows of 1½ ton rocks were pounding conveyor belts to death. Some split in two; others had their covers ripped off.

What was done: B.F.Goodrich engineers were asked to develop a belt that could stand the abuse. They started with the B.F.Goodrich cord belt, so called because it has cords running lengthwise, buried in rubber. To this they added several layers of Nyfil fabric, which gives extra strength to the belt without making it heavy and bulky. Special rubber compounds were used for the cover to stand the cutting and gouging of the rock.

Savings: The B.F.Goodrich belt was put to work here. It stood the banging, crashing better than any belt previously used. It lasted longer, carried more tons. B.F.Goodrich belts have now carried two-thirds of all the rock hauled out of here.

Where to buy: Your B.F.Goodrich distributor has full information on the conveyor belt described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-949, Akron 18, Ohio.*

B.F.Goodrich

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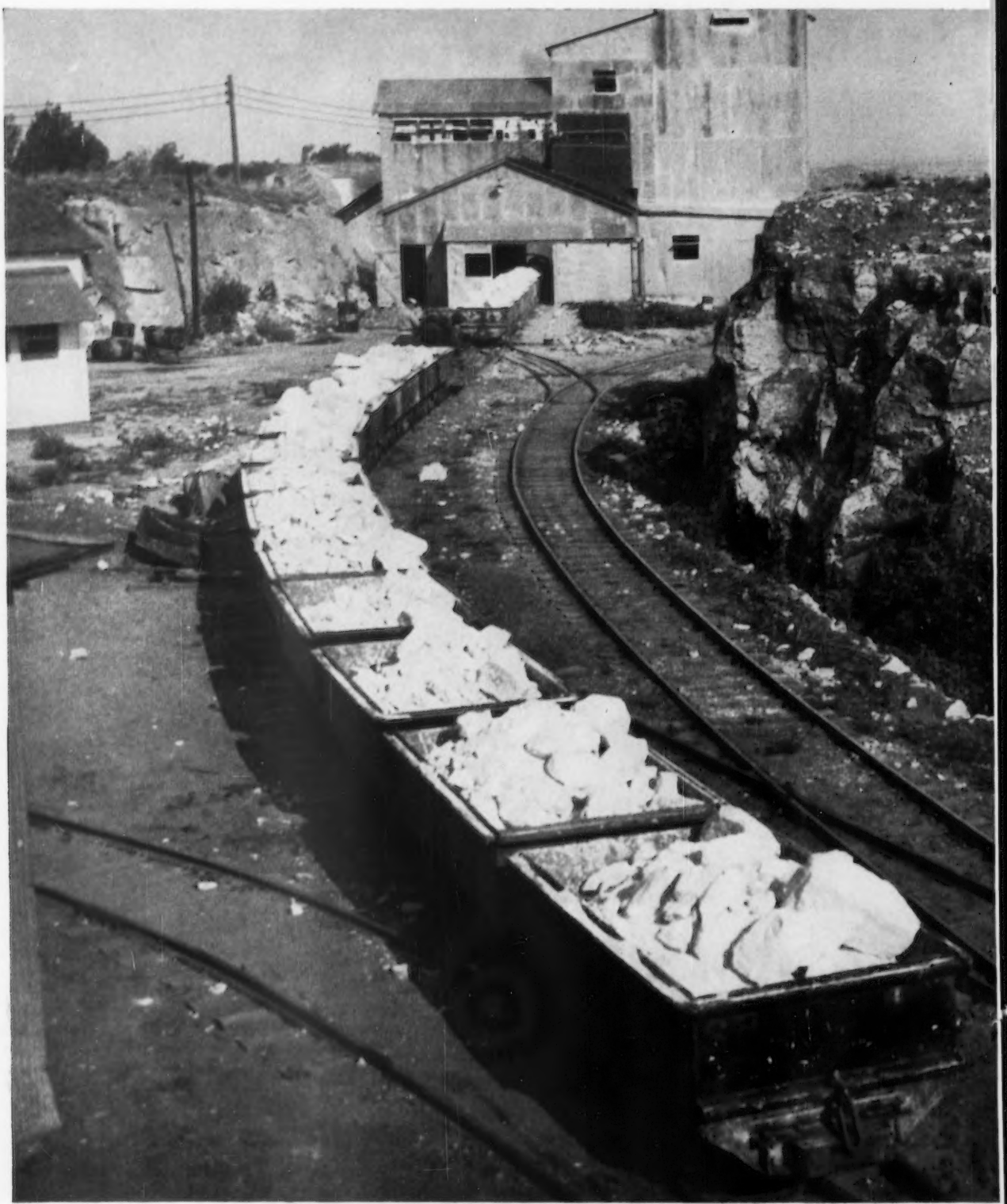

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- **Lubricating mine car wheels with *Texaco Olympian Grease* eliminates frequent maintenance . . . assures quick, easy starts even at summer and winter temperatures.**
- **Specially-developed *Olympian* protects mine car bearings, assures longer-than-average life.**
- **As a result, your cars keep rolling smoothly—give you more use because they're always ready to roll.**

SAVINGS add up fast when you lubricate mine car wheel bearings regularly with *Texaco Olympian Grease*. This fine lubricant assures quick, easy starts every time—resists stiffening at winter temperatures. Furthermore, it stays in the bearings under all conditions—gives longer-lasting protection against dirt, moisture and wear.

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FOR THE MINING INDUSTRY

Illustrative drawing showing principle of separation.

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higher capacity wet screening in the 8-48 mesh range with

THE DORR-OLIVER DSM SCREEN

The latest and one of the most significant advances in the Dorr-Oliver line of classification equipment is the Dorr-Oliver DSM Screen . . . developed for the high capacity wet screening of materials in the 8-48 mesh range.

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For more information on this newest tool for the mining industries, write for a copy of Bulletin No. 2300. Dorr-Oliver Incorporated, Stamford, Connecticut.

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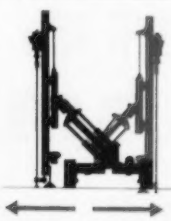
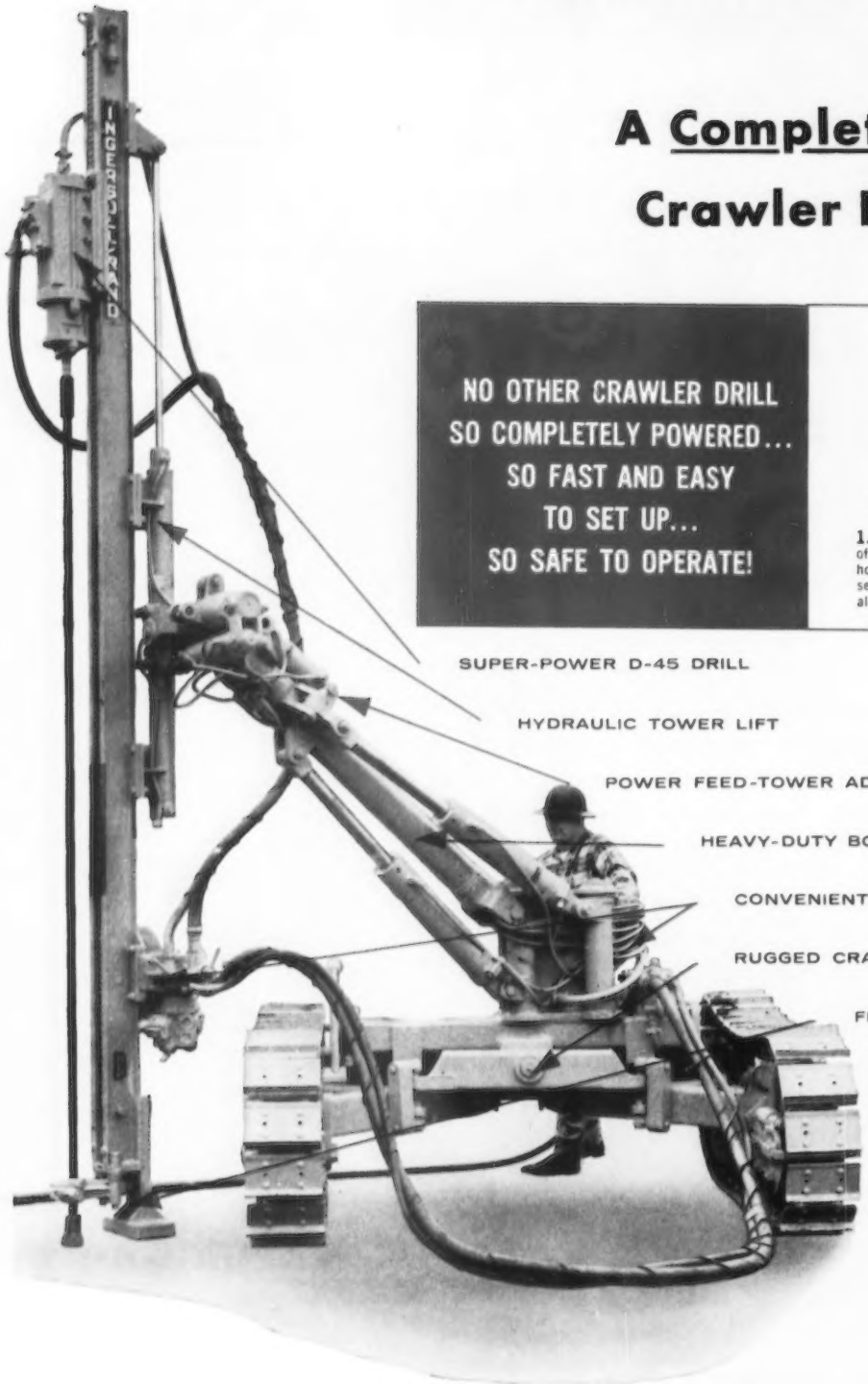
Announcing the

A Completely New, Crawler Drill at its

NO OTHER CRAWLER DRILL SO COMPLETELY POWERED... SO FAST AND EASY TO SET UP... SO SAFE TO OPERATE!



1. Hydraulic Boom Swing of 9'11" gives maximum usable hole pattern with a single crawler setup and permits line hole drilling along a face over the tracks.



SUPER-POWER D-45 DRILL

HYDRAULIC TOWER LIFT

POWER FEED-TOWER ADJUSTMENT (5 ways)

HEAVY-DUTY BOOM

CONVENIENT CONTROLS

RUGGED CRAWLER ASSEMBLY

FEED-TOWER FOOT PAD

MAXIMUM FLEXIBILITY WITH COMPLETE SAFETY

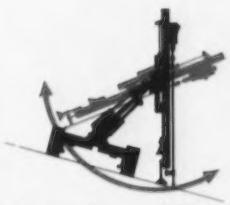
FOR A PACE-SETTING DRILLING COMBINATION,

Ingersoll-Rand CRAWL-IR

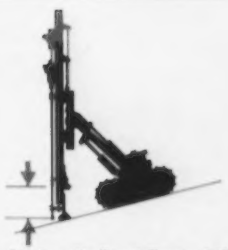
Completely Mechanized
RUGGED BEST!

2. Hydraulic Boom Lift raises and lowers booms in vertical plane—covers distance of 7'3" with tower in horizontal position.

3. Hydraulic Feed-Tower Tilt sets feed tower **at any angle.**



4. Hydraulic Feed-Tower Swing sets tower for vertical drilling on any slope—or positions drill for horizontal holes at any angle to crawler travel.



5. Hydraulic Feed-Tower Lift slides feed tower up or down, in or out—permitting foot pad to be set firmly on the ground.

HERE, in one unit, is a completely mechanized and self-propelled heavy-duty crawler drill that will greatly expand the scope of Wagon Drill operations. With *all* boom and feed-tower adjustments hydraulically controlled, you can make faster, safer and easier setups for drilling in *any position.* And because the CRAWL-IR can tow its own portable compressor, you save manpower and release auxiliary equipment generally required to move drills and compressors on the job.

The following advantages and features make this the fastest-acting, easiest drilling and safest unit of its type ever developed. It can be supplied with percussion or rotary drills, and with a wide range of optional hydraulic combinations when all of the power features are not required. Ask your I-R representative for complete information on this new self-propelled blast hole drill—or send for a copy of Bulletin No. 4189.

ADVANTAGES

SELF-PROPELLED — The CRAWL-IR is powered by two independently controlled heavy-duty piston type I-R air motors. Knee-action frame construction permits these motors to take the crawler over rugged terrain.

SPEEDS SETUPS — Five hydraulic cylinders quickly and safely position and lock the feed-tower in position by manipulation of convenient controls located on the boom base.

FAST STEEL HANDLING — Reverse rotation in the powerful D-45 drill when used with coupled steel provides a convenient and easy method of adding and removing steels in a hurry. The D-45 also incorporates release rotation which permits hammer action on the steel for loosening joints and fighting stuck steels.

MORE DRILLING TIME — The bulk of the time formerly spent on conventional Wagon Drills in moving, hand wrench time and steel handling is now turned into drilling time. With the drill positioning completely mechanized one man operation is entirely feasible.

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If your operation involves haulage with locomotives and cars in the 1 to 30-ton range, it will pay you to investigate the advantages of Willison Automatic Couplers.

Willisons are *Safer*—because they couple automatically...*Faster*—because they're self-aligning...*Stronger*—because they take the full buff and pull forces without depending on intermediate parts.

Over 100,000 Willison Automatic Couplers are in daily use in mines, industrial plants and foreign railroad service because they're *safer...faster...stronger.*

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▲ MILLION-DOLLAR ARRAY of equipment like this takes $7,000,000 relocation job on U. S. 21 in stride. This is just one of the many highway and airport grading and paving projects in Frank Mashuda Company's long and successful history. Tires shown are wide-base Hard Rock Lug by Goodyear.

◀ TYPICAL ON-JOB SETUP includes huge Quonset maintenance center and 2-way radio facilities. All vehicles and tires are kept in A-1 working condition at all times, on every job—and when no longer needed are returned to central maintenance center for general inspection and reconditioning. This has paid off, through the years, in one of the lowest down-time overheads in the industry.

80% of earth-mover tire down time ended by Goodyear

Other 3-T Nylon Cord Tires—
Tubeless or Tube-Type!

ALL-WEATHER EARTHMOVER

HARD ROCK LUG

HARD ROCK RIB

SURE-GRIP LUG

ROAD LUG

GOODYEAR TIRES

Look for this nearby Goodyear dealer sign for better tire values—better tire care.

3-T Cord TUBELESS!

CONTRACTORS REPORT that as much as 80% of tire down time is due to tube and flap troubles.

Goodyear TUBELESS tires and rims end all that—end high cost of tube replacement—and give you other important advantages:

Goodyear tubeless assemblies are *tops* in dependability, *tops* in easy mounting, save weight and run cooler. You often discover tire injuries *before* they become serious, repairs are simpler and can frequently be made *without removing tire!* As a result, tire failures hit all-time LOWS!

Be sure you specify GOODYEAR triple-tempered TRIPLE-TOUGH 3-T CORD TUBELESS for every size new equipment—and see GOODYEAR dealers for change-over of present vehicles.

Goodyear, Truck Tire Dept., Akron 16, Ohio.

Buy and Specify

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MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

All-Weather, Road Lug, Sure-Grip—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

Du Pont NILITE* for safer, powerful, low-cost shooting in dry work!

"Got any medium or large diameter dry holes to shoot? Man, if you don't use me, you're just plain wastin' money! Me? I'm NILITE: Du Pont's new ammonium nitrate blasting agent. Just pour me alone in easy shooting holes or as a top load in medium-hard ones. You'll get excellent spreading action, thanks to my over-60% weight-strength—and believe me, my price tag's low!

"Your work'll be safer, too. Caps, friction, shock and Primacord don't affect ol' NILITE. I'm also non-headache-producing, so your men can load faster, with an extra margin of safety. (For maximum safety, initiate me with Du Pont's "Nitramite*" Primer, although explosives of at least 50% strength can also do it.)

"I come two ways: in non-expanding round burlap-asphalt bags of 7", 8" and 9" dia. (larger sizes on request) for loading directly into holes—and bulk-packed, in 50- and 100-lb. multi-wall paper sacks that resist tearing and abrasion, for pouring into holes.

"Cut shooting costs—get all the power you need—by using me. That's NILITE: another field-tested Du Pont product you can bank on!" Call our man or write: E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington 98, Delaware.

*Registration applied for.

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BLASTING AGENTS
Products of Du Pont Research
DU PONT
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

NORTHWESTS
handle *ALL* iron mine excavation in British Columbia

You are looking down into Texada Mines of Texada Mines, Ltd., on Texada Island, B. C., about 50 miles north of Vancouver. Here you see two of the three Northwest 80-D, 2½ yd. shovels on the operation. The machines are digging and loading magnetite for shipment in bulk to Japan. Northwests have again proved themselves to be *real* Rock Shovels and have cut the cost of operation over previous machines of another make by $2.00 an hour.

Texada is one of several iron mines in British Columbia, all of which use Northwests.

This is hard rock digging. Magnetite is heavy and has a hardness of 6.5 and is probably as tough a digging test on equipment as is ordinarily found. Northwests are built for hard rock work. The Northwest Dual Independent Crowd, Northwest smoothness of operation, the Cushion Clutch and Uniform Pressure Swing Clutches combine with other Northwest advantages to permit you to get the most out of the equipment.

Check into Northwest advantages. Let a Northwest Man tell you all about Northwest features.

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SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

Convertible for any Mining Material Handling or Excavation Problem

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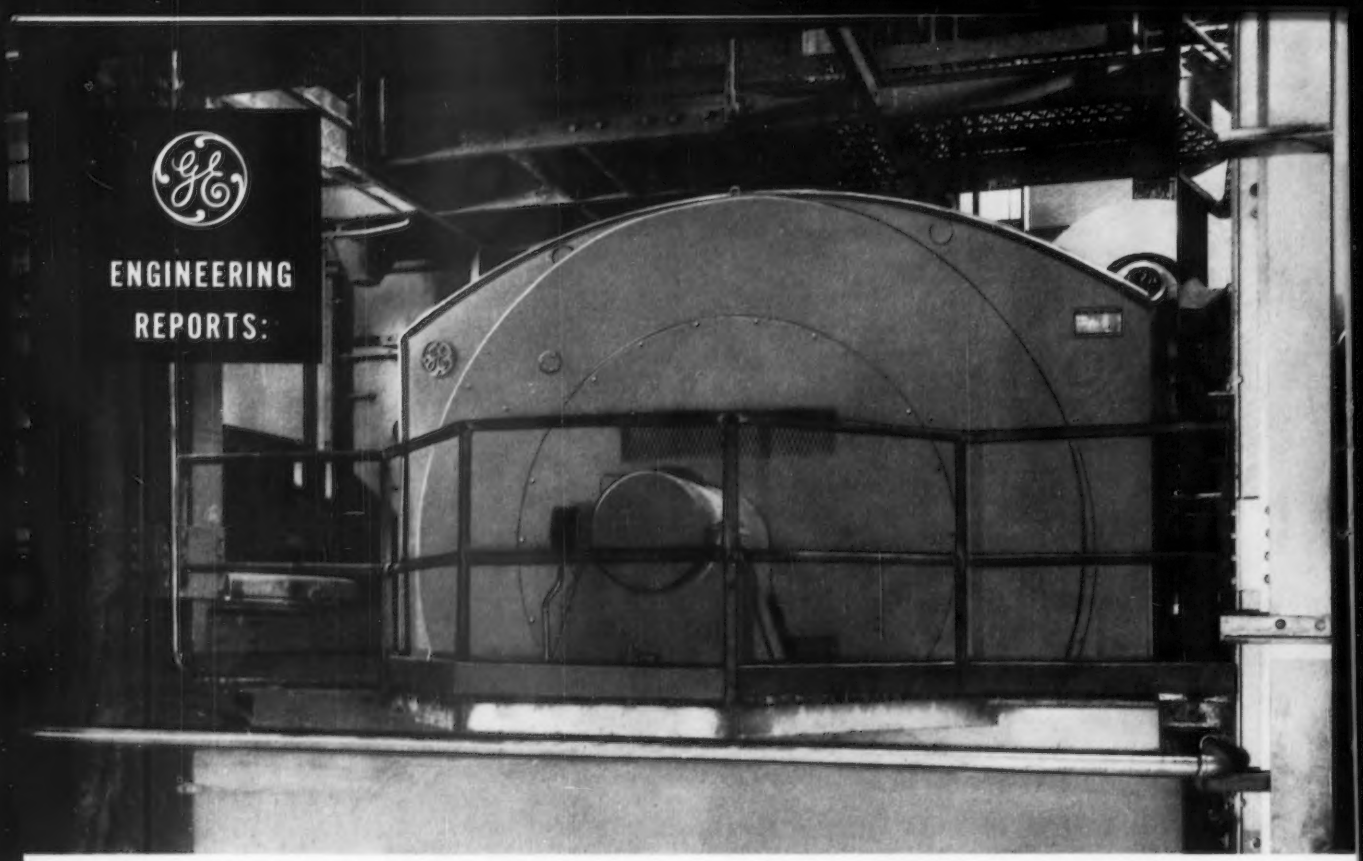
REPORTS:

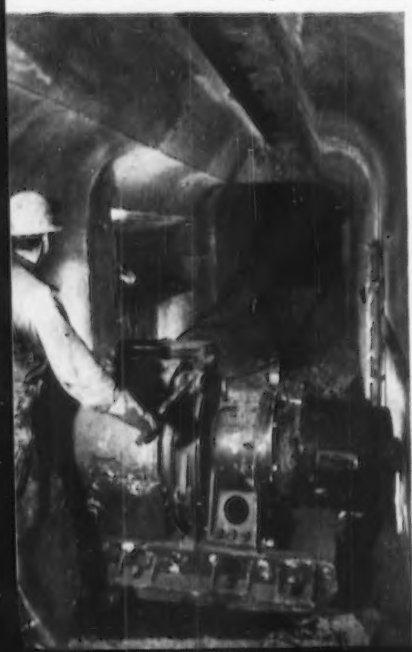


CAPACITY INCREASE of 3500 tons of ore per day resulted from installation of new #10 ball mill at Climax driven by this 1000-hp 2300-volt General Electric synchronous motor, giving continuous operation under heavy-duty conditions at high altitude.

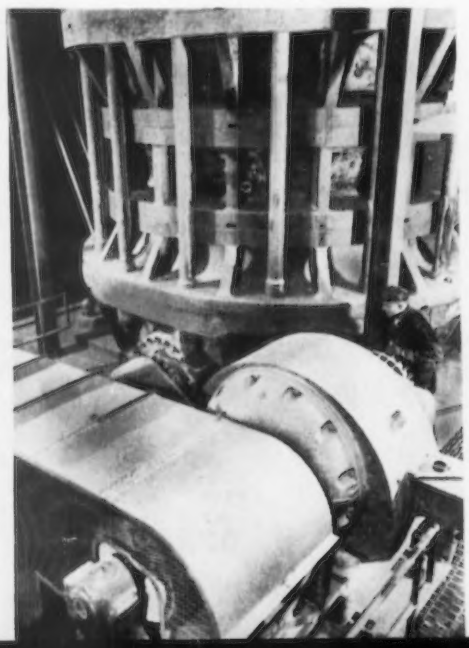
Using General Electric engineered system . . .

Climax Molybdenum exceeds

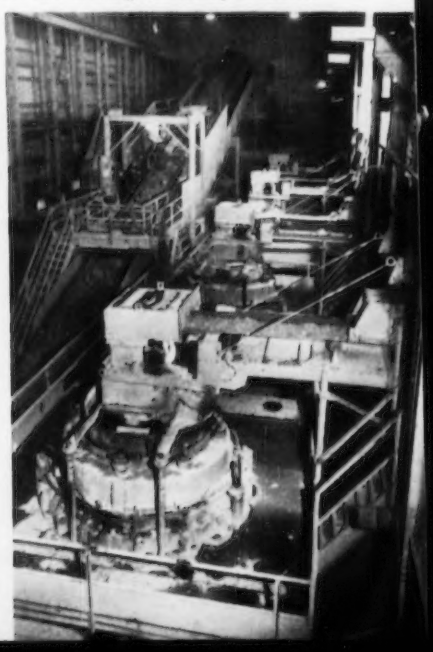
WITHSTANDING HEAVY shock loads, this all-fabricated-steel G-E 50-hp motor at mine's Phillipson level drives slusher hoist that dumps ore in cars.



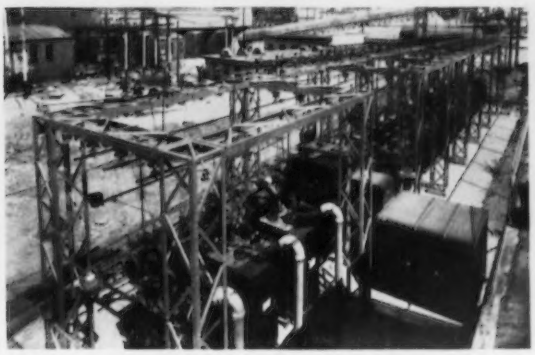
GYRATORY CRUSHER—one of world's largest—driven by 500-hp Tri-Clad* motor, is part of G.E.'s early participation in Climax's expansion plan. Located at Storke level. * *Reg. trade-mark of G.E. Co.*



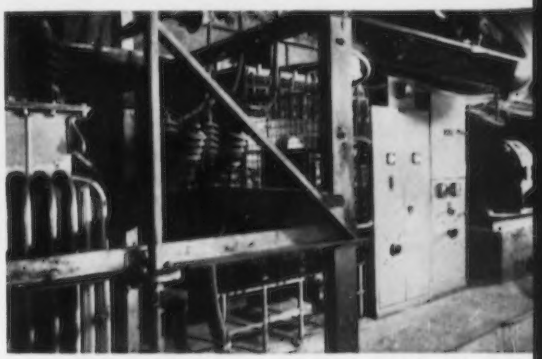
PROPER MOTOR TORQUES to meet crushing needs are provided by heavy duty 300-hp G-E synchronous motors driving secondary crushers.



CENTRALIZED G-E CONTROL for 1000-hp ball mill drive includes two control consoles (l. and r.) plus (center) Limitamp* high voltage starter and spotter, and motor control center for small drives. * *Reg. trade-mark of G.E. Co.*



HIGHLY DEPENDABLE POWER SUPPLY for new ball mill drive is provided by 2500-kva 13,800/2400-volt G-E master unit substation, recently integrated into substation lineup.



LINE VOLTAGE DROP is minimized by G-E power substation and 300-kw motor-generator set (r.), plus control, located underground near the working face.

former expansion goal by 20%

FLOTATION CELLS in Climax number 10 mill are driven by 70 General Electric Tri-Clad motors, in 5- and 7½-hp ratings, (seen below under G-E control console).

North America's largest underground mine boosts output 3500 tons of ore a day with new ball mill powered by General Electric drive

Continuing its $34 million expansion program which has already produced a record output of 31,000 tons of raw molybdenum ore per day, Climax Molybdenum Company, Climax, Colo., has once again hiked its production by 3500 tons a day with the installation of a complete new ball mill unit, powered, driven and controlled by General Electric system-engineered equipment.

When Climax began its expansion program in 1951—with an immediate goal of 28,000 tons of ore daily—G-E application engineers worked closely with Climax engineers to coordinate the project's electrical system. By helping provide a flexible, efficient electrical system, G.E. at that time helped pave the way for Climax's continued expansion to keep pace with the jet-age demands for the metal.

The same General Electric engineering leadership which helped Climax reach its record output is available to you for your expansion or modernization planning. Contact the nearest G-E Apparatus Sales Office early in the planning stage. General Electric Company, Schenectady 5, New York. 660-36

Engineered Electrical Systems for the Mining Industry

GENERAL ELECTRIC

Everytime a "95" Payhauler® leaves this shovel,

Camp Co. gets an extra 5 yds!

Day-to-day operational studies at Camp Concrete Rock Co., Brooksville, Fla., prove it! *Two International "95" Payhauler trucks, working with other haul units in the same capacity and power class, each carry an extra five yards every time they leave the 2½-yard shovel!* Loading time averages 2½ minutes for eight dippers or 20 yards. Haul length is approximately ¾ miles and includes a 10% adverse grade. The loaded Payhauler trucks travel this distance in 3 minutes, easily reaching load-carrying speeds of 34 mph. The empty return trip takes only 2 minutes, with the Payhauler trucks reaching top speeds of 38 mph.

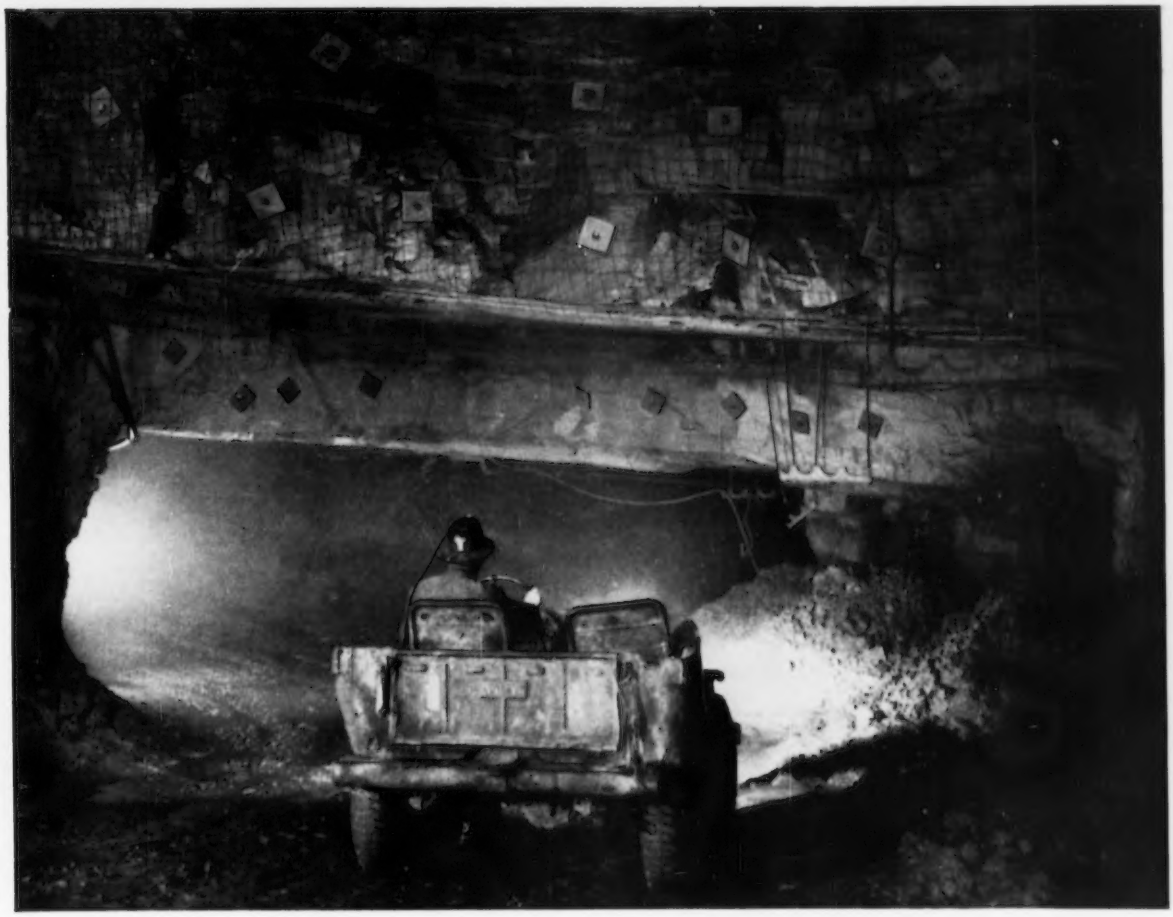
Counting waiting, spotting time over the grizzly, and dumping time, the Payhauler trucks average a complete cycle approximately every ten minutes. During Camp Concrete Rock Co.'s nine hour day, *this means an impressive total bonus yardage of approximately 225 yards per day from each Payhauler*... an International-inspired saving of thousands of dollars yearly over Camp Co.'s other units.

You've probably read of similar outstanding International Payhauler successes in the rock, stone, and quarrying industries. Now try the amazing "95" and "65" Payhauler first hand. Test the safe and easy full-load maneuverability...the ample power of the 335 hp turbo-charged diesel engine in the "95," and 250 hp turbo-charged diesel engine in the "65." Check fuel consumption, too. See how you can bank *10%* savings, as well. Your International Construction Equipment Distributor will be glad to give you an eye-opening demonstration.

INTERNATIONAL® CONSTRUCTION EQUIPMENT

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors...Self-Propelled Scrapers ...Crawler and Rubber-Tired Loaders...Off-Highway Haulers...Diesel and Carbureted Engines...Motor Trucks...Farm Tractors and Equipment.



Bethlehem Roof Bolts, used with square plates and wire mesh, in metal mine.

You get increased safety with Roof Bolting

Mines become safer, with the danger of severe roof falls unlikely, when you install Bethlehem headed roof bolts. This is because the bolts anchor overlying strata into a thick, secure beam.

Bethlehem roof bolts have other advantages, too. Their use makes possible wider openings and clearances . . . full use of mechanized equipment at the face . . . good ventilation, due to the absence of bulky supports . . . and no fire hazard.

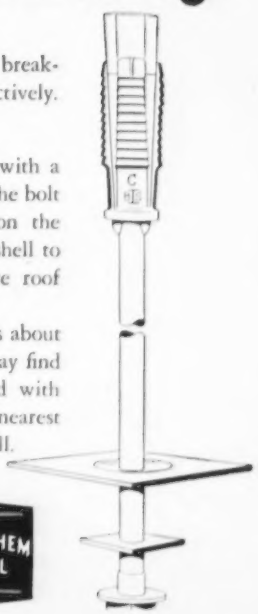
Four Types of Headed Bolt

The Bethlehem square-head roof bolt is manufactured in four types: a ¾-in. carbon-steel bolt and a ⅞-in. high-strength bolt, each of which has a typical breaking load of 24,000 lb; a ¾-in. and a ⅞-in. high-strength bolt, having typical breaking loads of 34,000 lb and 45,000 lb, respectively.

How Bolt Is Used

The Bethlehem headed roof bolt is used with a malleable-iron shell and steel plug. When the bolt is tightened, the plug is drawn down on the threads, expanding the four leaves of the shell to provide positive locking action. A square roof plate provides additional support.

We'll be glad to answer your questions about using the square-head roof bolt. Or you may find our 1-in. slotted roof bolt, which is used with a steel wedge, more to your liking. The nearest Bethlehem sales office is awaiting your call.



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

ONLY Allis-Chalmers

ALLIS-

MOTORS are "double protected"

New Integrated Field Coils Plus *Silco-Flex* Stator Insulation Provide Superior Motor Protection... Under Any Operating Conditions

1

Integrated Field Coils are bonded in heat-stabilized resins, enclosed in a resin-impregnated sheath of oriented glass fibers and bond-locked on the pole structure . . . dimensionally stable to withstand heating and thermal shock, vibration and fatigue at elevated temperatures . . . sealed throughout against atmospheric contaminants and fully protected against destructive forces.

2

***Silco-Flex* Insulation** provides a homogeneous, void-free insulating wall of silicone rubber on stator coils. It is unexcelled in life and thermal stability at high temperatures . . . resistant to most chemicals, water, weather . . . outstanding in flexibility and resilience . . . able to withstand abrasion and corona . . . resistant to physical and mechanical forces.

Exclusive Allis-Chalmers "double protection" is available on large electrical machines with operating temperatures through Class B range.

Silco-Flex is an Allis-Chalmers trademark.

For more information on these quality insulation systems contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin for Integrated Field Coil Bulletin 05R8525 and *Silco-Flex* Insulation Bulletin 05R8341.

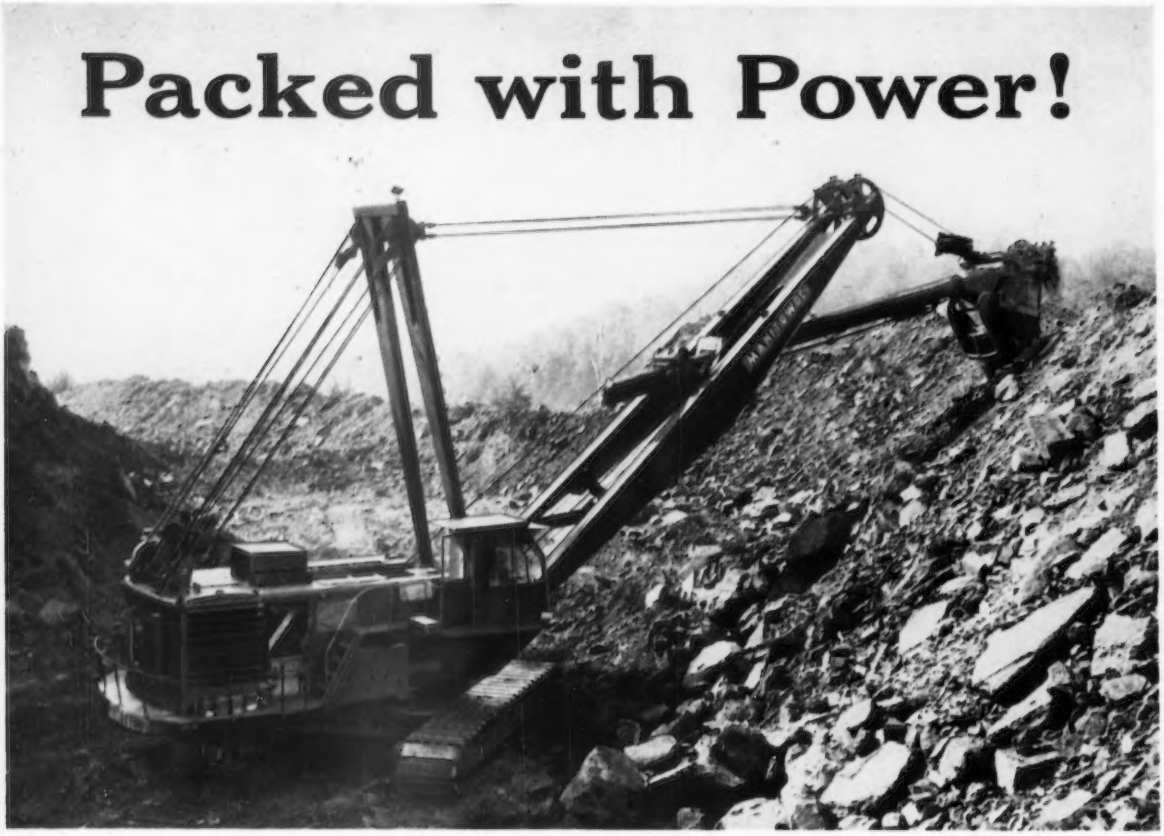
Allis-Chalmers "Double Protection," with integrated field coils and Silco-Flex stator coil insulation, adapts this 600-hp, 2300-volt, 600-rpm synchronous motor to the most severe operating conditions.

CHALMERS

A-C ALLIS-CHALMERS

A-5221

Packed with Power!



Manitowoc 4500 Boosts Mining Output

Smart mine operators with an eye on output figures have found that the Manitowoc 4500 loads out more tonnage faster — at greater profit. Here's a true mining machine — always ready to increase output — either as a 5½-yd., big capacity shovel, or a long reach, 6-yd. dragline.

FIRST WITH UNIT DRIVE. The Manitowoc 4500 is powered by a single diesel engine instead of independent electric motors and accessories. You get greater operating efficiency — less power loss with unit drive, pioneered and developed by Manitowoc for large crawler excavators.

UNMATCHED SIMPLICITY. You're rid of all the headaches and special maintenance problems brought on by electric drive. Several electric motors, generators, control boards and thousands of electric wires and connections are eliminated. Your regular mechanics easily handle routine maintenance and servicing.

"SMALL MACHINE" MOBILITY. Working range on the job is extended because there's no restrictive trailing cable — no need to stay close to power installations. When moving between jobs, the unit can be shipped on railway cars or highway trailers — then set up, ready to go, in less than a week.

Discover why more and more mines are switching to Manitowoc — Contact your distributor now!

Manitowoc Engineering Corp., Manitowoc, Wis.

- **Simple Design Throughout for Full Power — Less Deadweight — Less Downtime**
- **High Lift Booms Extend Reach and Height**
- **Tubular Dipper Stick Evenly Distributes Digging Strain**
- **Only 15 Gears and Sprockets — Only Working Gears Turn**
- **Amazingly Low Ground Pressure With Extra Long, Wide Crawlers**
- **Torque Converter Drive — Air Controls — Eliminate Operator Fatigue**

MANITOWOC

SHOVELS 1 - 5½ YD. Speedcrane CRANES 20-100 TON

LINK-BELT conveyors help Comstock Mine

control stockpiling, blending of ore by push-button

SMOOTHLY INTEGRATED Link-Belt ore handling system at Comstock Mine of The Colorado Fuel and Iron Corporation conveys ore from crusher house to storage and railroad spur, with screening and sizing performed en route. Mine is operated by Utah Construction Company.

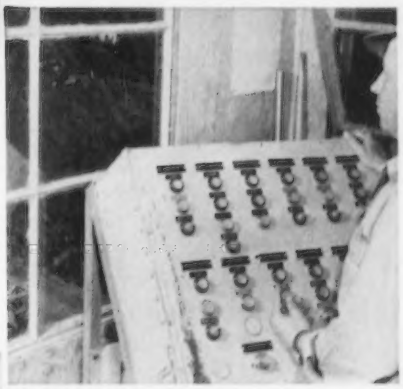
Integrated system moves 1000 tph to storage . . . reclaims 1500 tph

THE latest in modern ore handling techniques are incorporated in the Link-Belt engineered system at Comstock Mine, Iron Mountain, Utah. A single operator uses push-button controls to direct operation of seven belt conveyors, a vibrating screen, two traveling stackers and various gates and chutes—regulating stockpiling, blending and delivery of ore to railroad cars.

If any phase or all of your ore handling requires modernization or mechanization—call your nearby Link-Belt office. Here is a broad line of equipment, backed by unrivalled engineering facilities—your assurance of lowest cost per ton handled.

LINK-BELT

CONVEYING AND SCREENING EQUIPMENT



EXTREME FLEXIBILITY is possible through seven settings of the flow selector switch, which permits controlled distribution to storage and car loading conveyors.

STOCKPILING ORE BY GRADE with one of two belt conveyors and traveling stackers. In reclaiming, various grades of ore are blended to meet blast furnace requirements.

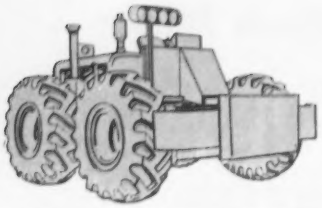
CAR-LOADING BELT CONVEYOR beneath screening tower is fed by two reclaim tunnel belts, or by upper conveyor from crusher house which can bypass stockpile.

LINK-BELT equipment at Comstock Mine

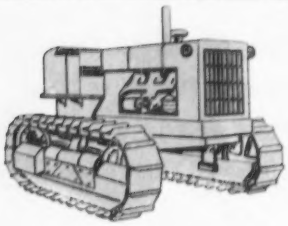
- Feeders
- Scalpers
- Belt conveyors
- Vibrating screens
- Traveling stackers
- Tunnel gates
- Drives
- Controls

14.485

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Where to apply RUBBER



Where to apply CRAWLERS

to put more profits in your pocket

Both rubber-tired and crawler tractors may have a place on your pit operations. But where does each fit to your best advantage? Where can each be applied to put more profit in your pocket?

Let's look at crawlers:

Crawler tractors fit your applications where lugging power is a maximum requirement. They work well for heavy dozing in soft, slippery mud, or in tough, rocky materials. They produce at maximum efficiency in long-term operations within limited areas. In such conditions, their traction advantage at low speeds can offset their speed limitations on medium or long-range cycles.

Let's look at rubber:

Rubber-tired tractors fit your applications best where *speed* and *mobility* are important factors in your pit operations. You'll find their greatest value on jobs like cleaning up around shovels, removing overburden, maintaining haul-roads, toeing-in stockpiles, leveling waste, pushing or pulling rubber-tired scrapers, pulling out stuck trucks, and towing portable drills and other equipment over the pit floor to new work sites.

On your longer dozing cycles, too, the speed of rubber-tired tractors is of great importance. Here speed and mobility may cut your dozing time in half, or enable you to get twice as much work done. On scattered assignments around your pit, this combination of power and speed can save you much time and money — put more profits in your pocket.

You measure production on your shovels, your hauling equipment, your drills. It is also important that you study carefully the work capacity of your tractors. It is true that yardage measurements are impossible on most

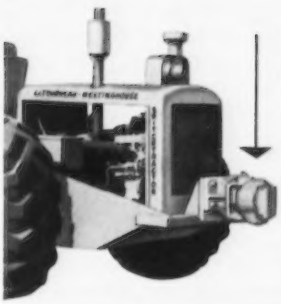
New Mexico

Illinois

of their production . . . but you can "clock" your tractor moves and cycles over a substantial period of time to your ultimate advantage. We'll be glad to compare Tournatractor® time studies with you, or demonstrate this rubber-tired tractor on your job to show its outstanding advantages in speed and mobility.

You will want to see the modern, improved Tournatractor. Study it from the angle of your assignments where you need *speed* and *mobility*. Then study your crawler cycles, but not just on the basis of the biggest load in the shortest distance. Measure in *time* rather than *distance*. Measure load-time, carry-time, turn-time, return-time. Find out the percentage of time you lose in moving from one assignment to the next.

With more than eleven years of experience and constant improvement behind it, the rubber-tired Tournatractor of today can meet your need for fast, dependable performance, with a minimum of maintenance. Its operation is easy and safe. You can use Tournatractor to profitable advantage on your pit operations.



SwitchTractor®, illustrated above, is Tournatractor with RR coupling attachment (shown at left) for combination of regular tractor applications — plus RR switching service, anywhere and anytime you need it. Operating at Anaconda Co.'s uranium mine and rail terminal near Albuquerque, this versatile SwitchTractor crosses, straddles rails. Tires pull on tie-ends, give far more traction than switch-engine's steel wheels on steel rails.

See how work-and-run mobility puts more profits in your pocket . . . next page ▶

Here's how work-and-run MOBILITY puts more profit in your pocket every working day

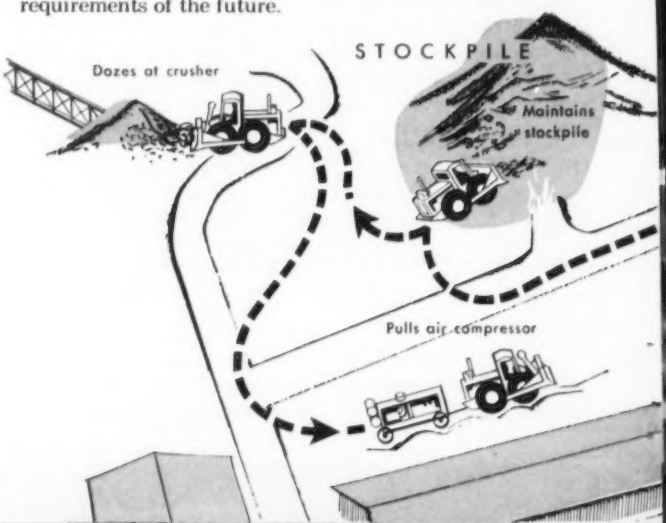
No matter where it operates, your tractor-on-rubber is only a few minutes away from its next assignment . . . anywhere in your pit area. In less than 4 minutes, Tournatractor® can be a mile away to maintain stockpiled material, level at the waste dump, or clean-up around a shovel. There's no delay . . . no waiting for truck and trailer . . . no loading or unloading . . . no extra equipment or manpower expense. Operator just shifts into high, and he's on his way.

Rolling on big 2′ wide, low-pressure tires, 17 mph Tournatractor always takes the shortest route via haul-road or across the pit. It travels easily over pavement, sidewalks, curbs or RR tracks . . . without planking. Big, low-pressure tires spread to take the load, flex and roll easily over obstacles. There are no links to break under concentrated loads; no grousers to cut into concrete or blacktop. There is no penalty in high track-wear for long, fast moves. Tournatractor has a fully-enclosed anti-friction drive all the way; no multitude of wearing parts, no pins and bushings to wear out and replace, no rock-crushing rollers to rob power and grind abrasives that help wear out expensive track assemblies.

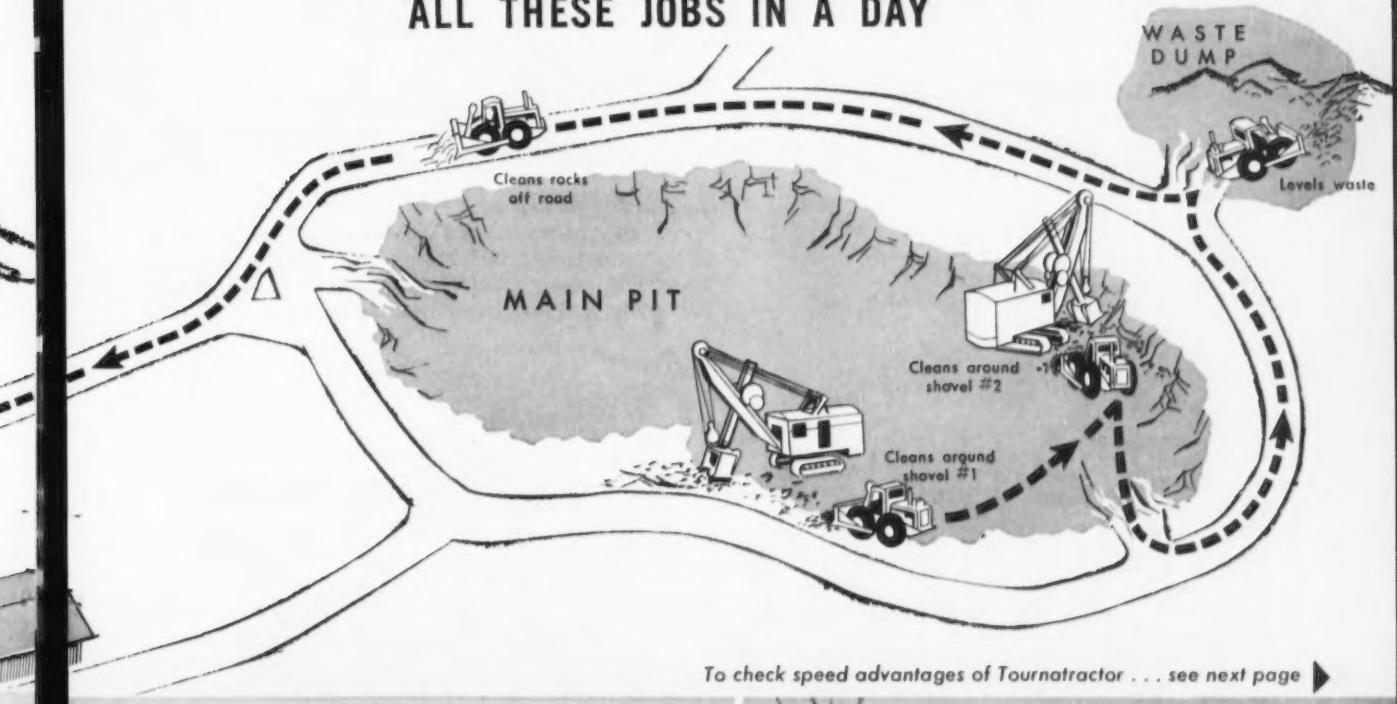
On the job, Tournatractor's quick mobility lets you move anywhere, anytime, to handle scattered maintenance assignments throughout your pit. Often it gets to a distant job, completes the assignment, and returns — before your crawler can be loaded on a trailer, blocked securely, and moved to the job to begin work.

Should you want to move your Tournatractor to another pit, your operator can easily drive it down the highway, through regular traffic, to the next work site.

Tournatractor's rubber-tired mobility will mean even more to you with the bigger pit and higher production requirements of the future.



ONE TOURNATRACTOR CAN HANDLE ALL THESE JOBS IN A DAY



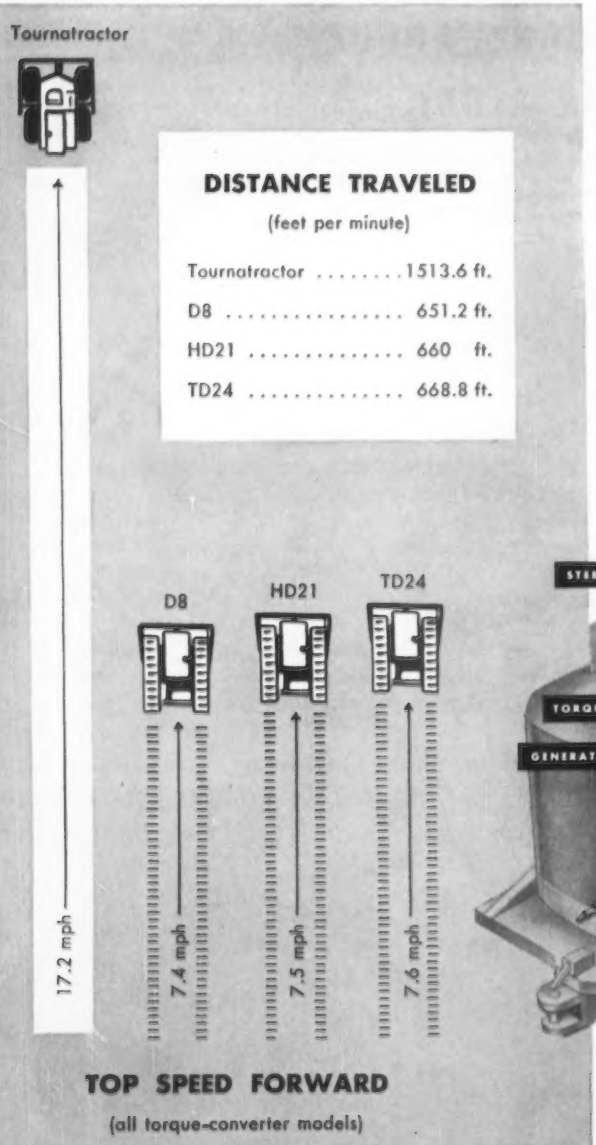
To check speed advantages of Tournatractor . . . see next page ▶

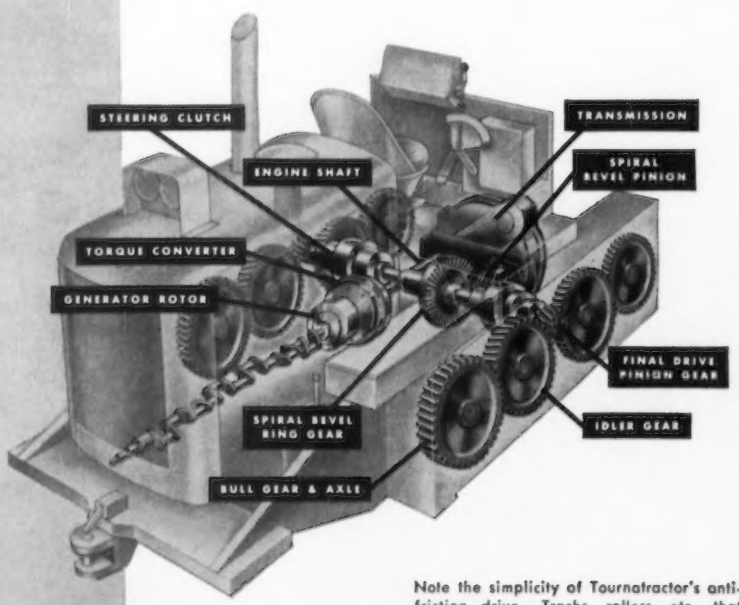
These SPEED advantages put more profits in your pocket

Tournatractor's 17.2 mph top speed, more than twice that of modern crawlers, is a valuable asset in time-saving and economy for job-to-job moves and for quick service anywhere on the job. But these obvious advantages of high-speed mobility are only a part of Tournatractor's speed story.

With its constant-mesh transmission, Tournatractor® has instant gear-shifting which can save as much as 80 minutes per 10-hour day on a dozing or pushing application.

In addition, behind its standard torque converter, high-speed Tournatractor has 4 gear combinations for use in forward movement, and 2 in reverse. This gives better speed and power relationship, less loss in torque-converter slip, and less danger of excessive heat.





Note the simplicity of Tournatractor's anti-friction drive. Tracks, rollers, etc., that operate in abrasive dirt are eliminated. You roll on top of the dirt on self-cleaning tires that give you high-speed operation.

Inherent in Tournatractor's four-wheel drive is a definite speed advantage in quick acceleration due to its all-sealed, anti-friction drive. Not only do you have instant shift, but, without the drag accelerating some 500 moving and wearing parts in the track linkage of a crawler, you step right out and GO. Tournatractor will accelerate to its top speed of 17+ miles per hour in less time than a crawler can get to its top of 7+ mph.

In studying value of speed in the application of crawlers versus the application of Tournatractor on dozing and pushing cycles, it is important to remember that *time* is the key factor. When comparing only crawlers, since their available speeds are approximately the same, you can get a fair comparison of efficiency by noticing the distance required for each to get a full load. But, in comparing Tournatractor with crawlers, it is important that you check loading time for each with a stop watch. This is because the many speed factors in the Tournatractor cycle often more than offset extra loading distance which may be needed in hard or difficult materials. Though the Tournatractor operator applies his equal power to work with a thinner bite, he'll get the same load over a greater distance — probably in less time.

Consider, too, that Tournatractor's quick maneuverability and fast acceleration is also a speed factor for fast, accurate dozing or in positioning for push-loading. Reverse cycles, too, are faster with Tournatractor because of the instant reverse, constant-mesh transmission, and quick overall maneuverability.

Ask for further information

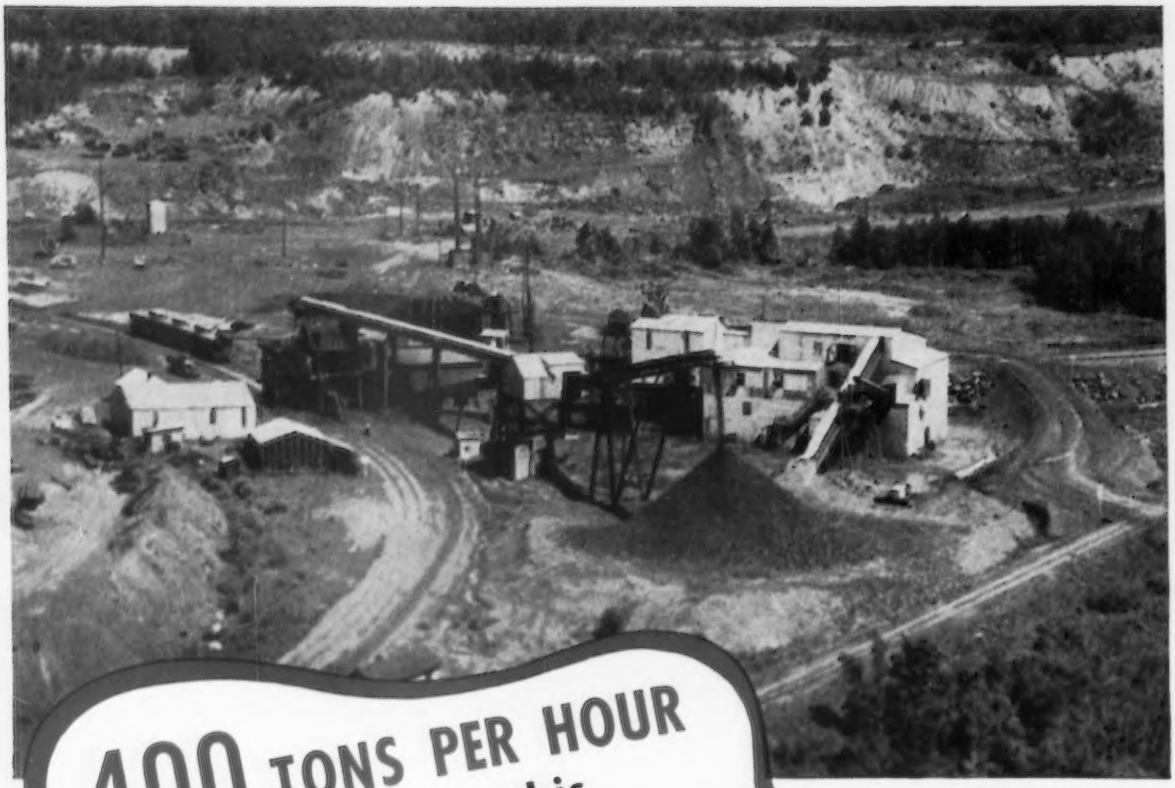
Before you buy your next tractor, consider your needs for *speed* and *mobility* in your operations. See your nearest LeTourneau-Westinghouse Distributor for more information on how Tournatractor can fit these needs. He will be glad to demonstrate this versatile tool so you can personally check its performance. There is no obligation — call him today.

CT-1437-M

LeTourneau-**WESTINGHOUSE** Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



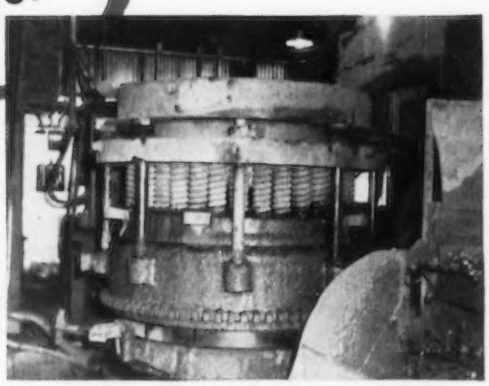
Custom mill of Skubic Brothers, Virginia, Minnesota.

400 TONS PER HOUR processed in this custom mill with TELSMITH Equipment

● Processing low grade and other ores, this Minnesota mill has a total capacity of 350-400 tons per hour. About 40% is 4″ to plus 1¼″ and goes to a 48-S Telsmith Gyrasphere Crusher. Its long, high speed crushing stroke gives maximum capacity. Its spherical head makes a uniformly finer product. Cam-and-Lever crushing action, with roller bearings, and other Telsmith mechanical advantages keep power and maintenance expense down, result in very lowest crushing cost per ton.

● Material not crushed, about 60%, is minus 1¼″ and goes to a high capacity 96″ Telsmith Super-Scrubber which turns out remarkably clean ore at minimum cost.

● Get Bulletin 266.



TELSMITH GYRASPHERE CRUSHERS

Min. 37

SMITH ENGINEERING WORKS

502 E. CAPITOL DRIVE **MILWAUKEE 1, WISCONSIN**

Representatives in Principal Cities in All Parts of the World • Cable Address: Sengworks, Milwaukee

Heavy-duty Adams grader improves, maintains haul-roads . . . smooths plant area. Better roads pay off in faster, lower-cost hauls from mine or pit to plant.

Big ALL-JOB grader

extra power for heavy-duty grade work

Here's a BIG grader with work-capacity to match . . . a machine that handles all grade work at lowest cost. It's the 150 hp Adams 660 . . . a 30,200 lb. machine geared to fast, modern work methods.

15 speeds boost output

Adams 660 really makes the dirt "fly", with more power-speed combinations than any other conventional transmission grader. For your *normal work-range*, "660" gives you 4 full-power forward speeds (2.3 to 6.7 mph) instead of 3. It provides 2 reverse-work speeds as against the usual 1. You get "just-right" power and speed for all every-day blading operations.

Three optional *creeper speeds*, as slow as 36 feet per minute, provide extra "muscle" for rugged work . . . controlled power for precise blading and work in rocky soil.

Add to this *high travel speeds* (forward and reverse) that cut-down wasted time . . . add *productive* minutes for *haul-road maintenance*. 4 forward gears (10.3 to 26.0 mph) speed maneuvering, make hill climbing easier, cut travel time. And "660's" 2 faster reverse speeds (to 13.7 mph) save many turn-arounds . . . give up to 30% bonus production on one-way work.

Positive controls speed blading

Your operator works faster, more precisely with smooth Adams blade controls. Three-jaw clutches engage without chatter or kick-back. Direct-drive power is applied steadily. Your operator can *depend* on blade operation at constant speed — no matter how many other controls are actuated. There's no vibration because all clutches, gears, shafts, and universal-joints move on anti-friction bearings.

Attachments widen work-range

There are a number of *specialized* attachments you may want to add to the "660" . . . now or later: *Scarifier* for opening-up clay, rock-filled soil, or old roadways . . . *push-plate* for push-loading scrapers, or starting stubborn equipment . . . *bulldozer blade* for odd-lot casting and back-filling . . . *Elegrader* for stripping topsoil, loading dirt, casting ditch-material, building up roads . . . *snow equipment* for winter snow removal work.

Also, 190 hp "660" with torque converter

For maximum push-power at all speeds between 0.0 and 27.4 mph, LeTourneau-Westinghouse offers the new POWER-*Flow* 660. This super heavy-duty grader applies 190 hp thru torque converter to give you the effective work-power of an *infinite* number of power-speed combinations. POWER-*Flow* 660 plows thru varying loads at constant speed . . . will not stall . . . starts extra-heavy loads without lugging. Torque converter cushions engine and drive against shock . . . makes operation simpler, more efficient.

Ask for a demonstration

Call or write, and ask us to show you how Adams graders — all 6 sizes, 60 to 190 hp — work faster, cut deeper, blade truer, put-out more finished work than any other grader of similar size and power. In the 190, 150, 123, 104 and 80 hp sizes, you have a choice of GM or Cummins diesel engines.

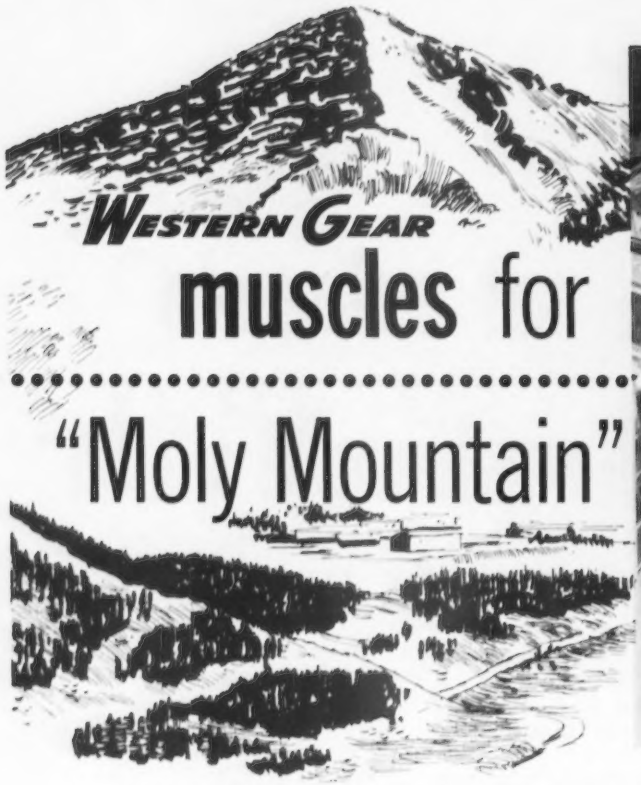
This fast-moving Adams grader keeps pit floor clean . . . saves wear on fleets' tires and treads. Permits driving haul equipment by shortest routes, and improves drainage.

Adams, POWER-Flow—Trademark AG-1223-M-b-6

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

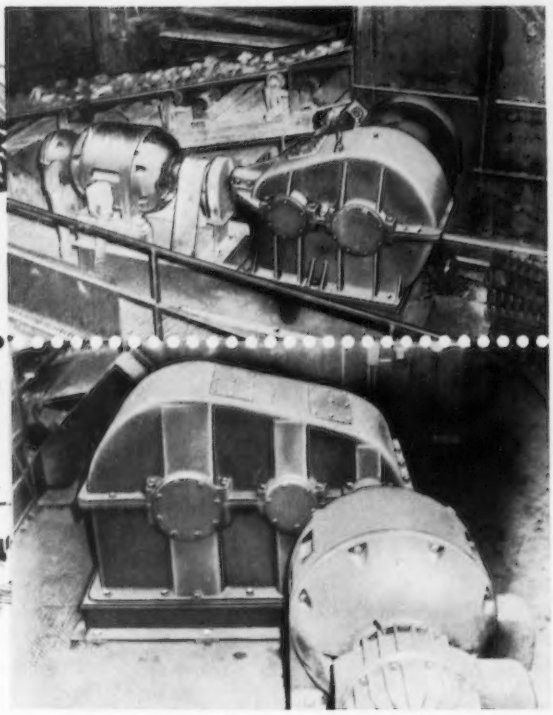
A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



WESTERN GEAR muscles for "Moly Mountain"

Here, a Western Gear BH-356-S unit drives the conveyor from the surge bin to grizzley for the 7-foot cone crusher. This unit has a ratio of 35 to 1.



This Western Gear OD-62-S speed reducer needs plenty of muscle to drive the 60-inch-wide conveyor from the gyratory crusher to the surge bin. Ratio is 35.8 to 1.

Western Gear speed reducers furnish the muscles that move thousands of tons of vital molybdenum ore every day at the Bartlett Mountain, Colorado mine of Climax Molybdenum Company. The Western Gear BH-356-S reducer moves 900 tons of ore per hour, driving a 284-foot-long conveyor with a lift of 73 feet, 14 hours a day, 306 days a year. The mighty OD-62-S speed reducer moves 2,000 tons of ore per hour at a rate of 375 feet a minute up a lift of 81 feet. Molybdenum, vital to steel production as an alloying element, is in too great demand to allow breakdowns in mining operations. That's why Western Gear dependability is essential to "Moly Mountain," where muscles with built-in reliability are moving a mountain to industry.

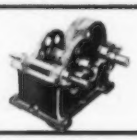
WRITE TODAY! Get the whole story of Western Gear's installation at "Moly Mountain" It's yours for the asking. Write Glenn Malme
WESTERN GEAR CORPORATION
P.O. Box 182, Lynwood, California

Below are shown other members of the WESTERN GEAR quality line of dependable mechanical power transmission equipment.

High Speed Unit

Right Angle Speed Reducer

Strait Line Speed Reducer



Parallel Shaft Speed Reducer

All Motor Gearmotor

"The difference is reliability" • Since 1888 5756

WESTERN GEAR Corporation
ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.)
SEATTLE AND HOUSTON—REPRESENTATIVES IN PRINCIPAL CITIES

"Obtained excellent performance"

hauling blasted limestone to supply Argentine cement factory

At an important limestone quarry in Yocsina, Cordoba Province, Argentina, three Model D Tournapull Rear-Dumps work all the year around hauling blasted limestone rock to crushers. Machines are owned and operated by **"Corcemar" Corporacion, Cementera Argentina, S. A. of Cordoba.**

After limestone is crushed, it is hauled by trucks from the quarry at Yocsina to "Corcemar's" main cement factory, about 20 miles away.

396 tons in 5.3 hours

Rear-Dumps hauled the blasted limestone about 1,100 feet uphill to the stone crushers. These Tournapulls, full loaded, regularly traveled the haul route in 3rd or 4th gear up grades averaging 4.6%, at speeds of 12 to 20 miles per hour.

On these 2,200-foot cycles, each D Tournapull delivered 400 short tons of limestone during an 8-hour shift, although about ⅓ of the working time was spent in waiting for other equipment. Individual Tournapull loads averaged 9½ short tons on this operation, according to the engineer speaking for "Corcemar" Corporacion.

Tournapulls were working at reduced efficiency when this job was visited, because difficulties in hauling away crushed limestone made it impossible for crushers to operate at full capacity. Upon completion of a new storage bin, however, the three Tournapulls' increased speed and production can be fully applied to keep crushers supplied.

Impressed by this production, Ingenierio Blanc comments that the company has "obtained excellent performance from these Tournapull Rear-Dumps."

675 hours of use; no downtime

Accurate maintenance records were kept while the three machines worked respectively 166, 254, and 255 hours. During this period, none of the machines experienced any downtime at all.

Why not learn more about what the power, speed, and mechanical efficiency of Tournapull Rear-Dumps can accomplish in *your* materials-handling work? Write us for owner-verified production figures on the size Rear-Dump best suited to your needs. These LeTourneau-Westinghouse haulers are built in three sizes, 138, 208, and 293 hp, with 11, 22, and 35 short ton capacities . . . a size for every need.

Tournapull—Trademark Reg. U.S. Pat. Off. DR-1083-Q-b

Tournapull dumps a full load of limestone into one of the two stone crushers at this Yocsina quarry. Electric switch activates hoist motor. Body lifts quickly, swings low behind rear wheels to dump clean into the grizzly.

This D Tournapull Rear-Dump is heaped with 9½ short tons of blasted limestone by a 2-yard shovel, at a quarry in Cordoba Province, Argentina. Wide bowl opening of these Rear-Dumps provides an easy loading target.

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

ADAMAS CARBIDE INSERTS

. . . the choice of leading rock bit manufacturers

Years of intensive research and manufacturing know-how by leading rock bit manufacturers have made possible the efficient rock bits you use today. It was logical that in the choice of a tungsten carbide insert for their product, these same leading manufacturers should seek out the tungsten carbide manufacturer whose inserts offer the best combination of wear and shock resistance.

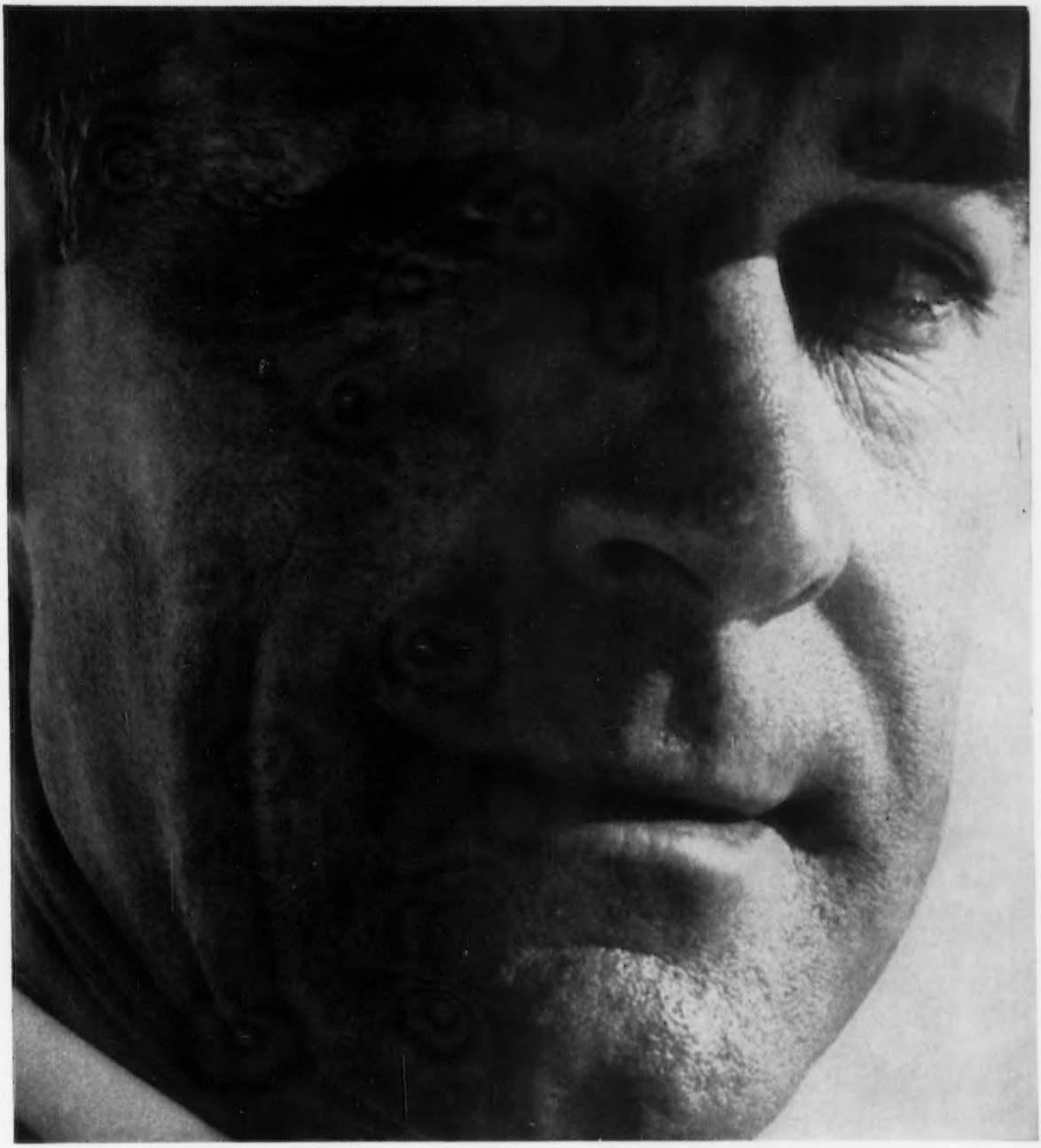
Adamas Carbide Corporation is justifiably proud to have been chosen as the major source by leading rock bit manufacturers throughout the United States and Canada. Adamas rock bit inserts have repeatedly demonstrated top performance shock and wear resistance under all types of mining conditions . . . from the iron and uranium mines of northeastern Canada to the copper mines of Arizona.

Through coordinated research and development with your rock bit manufacturers, the *Adamas Carbide Corporation* is continuing the expansion of its line of job-engineered carbide grades. This teamwork will bring you the benefits of more efficient drilling through superior performing rock bits with Adamas carbide inserts.

The fascinating story of the development, manufacture, and productivity of carbides is told in an interesting booklet titled, "THE HARDEST METALS MADE BY MAN". Copies may be obtained by writing to:

ADAMAS CARBIDE CORPORATION, KENILWORTH, N. J.

PRODUCERS OF TUNGSTEN CARBIDE TOOLS, TOOL TIPS, DIES, WEAR PARTS, DEX-A-TOOL AND CERALOX

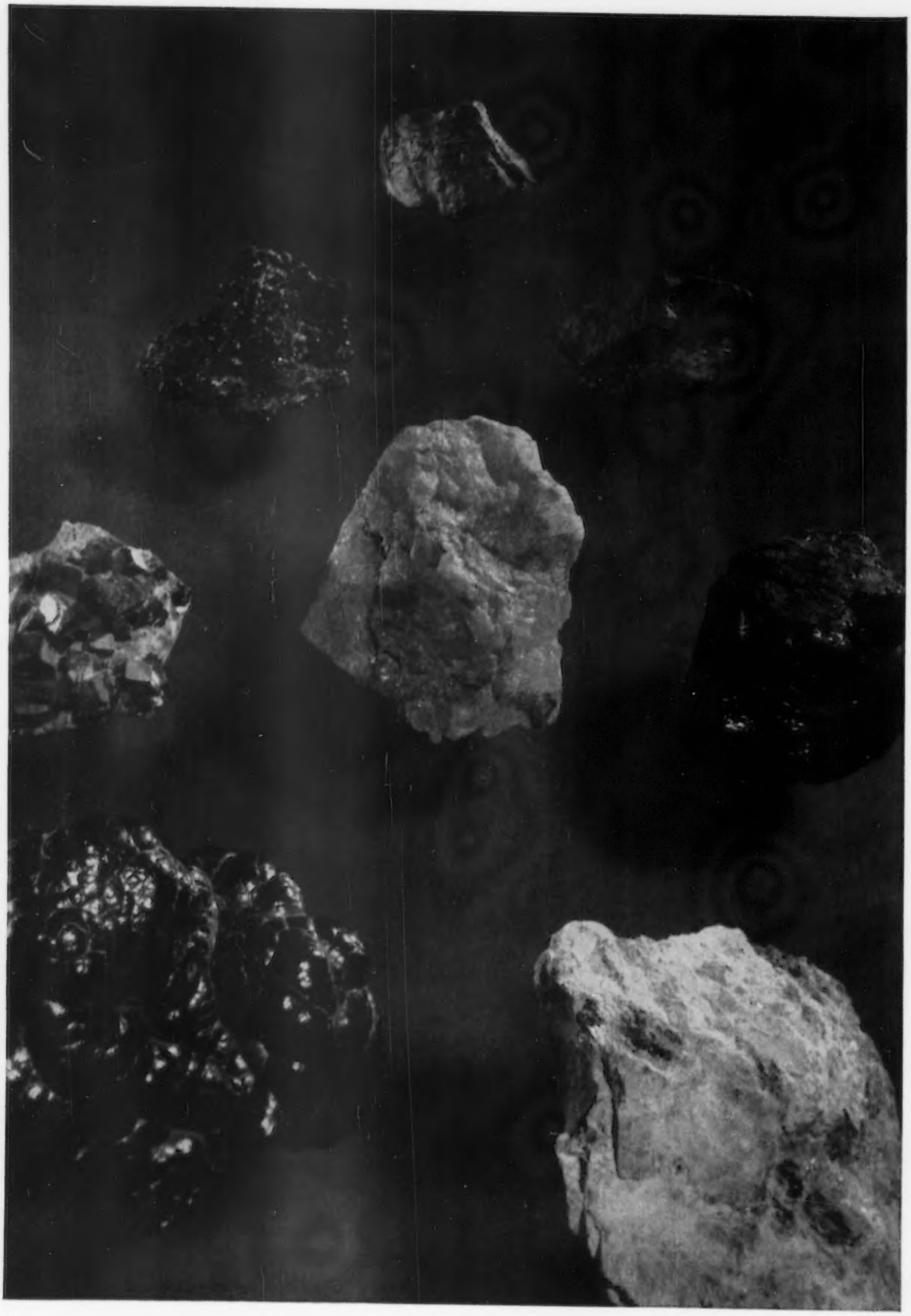


When your process calls for chemicals talk to the man from Dow

YOU CAN DEPEND ON DOW FOR: XANTHATES • DOWFROTH® 250 • Z®-200 • SEPARAN 2610® • HYDROCHLORIC ACID • AMMONIA • CHLORINE CAUSTIC SODA • VERSENE® • MAGNESIUM OXIDE • MAGNESIUM HYDROXIDE • ION EXCHANGE RESINS • SOLVENT EXTRACTANTS

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

DOW



These represent a few of the minerals with which Separan 2610 is improving flocculation and lowering processing costs: CHROMITE, URANINITE, GALENA, SPHALARITE, CHALCOCITE, ALUMITE, COAL, HEMATITE.

For a wide variety of minerals Separan 2610 provides record-speed flocculation

NEW FLOCCULANT PROVES ITSELF IN NUMEROUS OPERATIONS

It's a fact—proven in many types of operations, with a wide variety of materials: Separan 2610® has doubled, and often tripled, production rates!

Equally remarkable: only a few hundredths of a pound are needed per ton of solids!

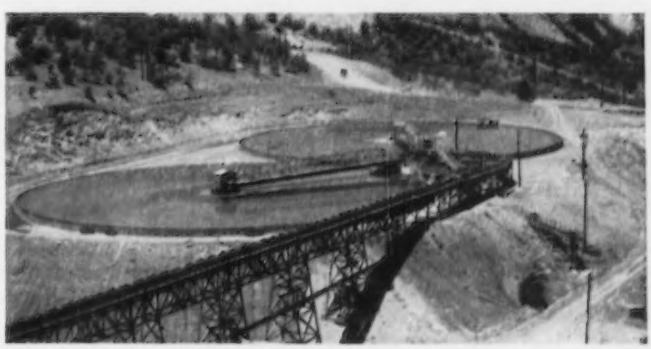
New economies are being realized in processing uranium, lead, and zinc, coal, copper, alum, and a host of other sulfide and non-sulfide minerals. Operations involving concentration, leaching, thickening, and refining are benefiting with Separan 2610, especially since this revolutionary flocculant is so easy to prepare and apply. A mechanical mixer is not required. You can prepare large amounts of stock solution with a new dispenser recently made available. And Separan 2610 is effective in both acid and alkaline circuits. In addition, it adds no excess bulk.

Try Separan 2610 yourself!

Available from three f.o.b. points: Midland, Michigan; Pittsburg, California; and Velasco, Texas . . . and from two stock points: Port Newark, New Jersey, and St. Louis, Missouri. A sample and technical assistance are yours upon request. THE DOW CHEMICAL COMPANY, Technical Service and Development, Midland, Michigan, Dept. S21315A-1.

When your process calls for chemicals, talk to the man from Dow

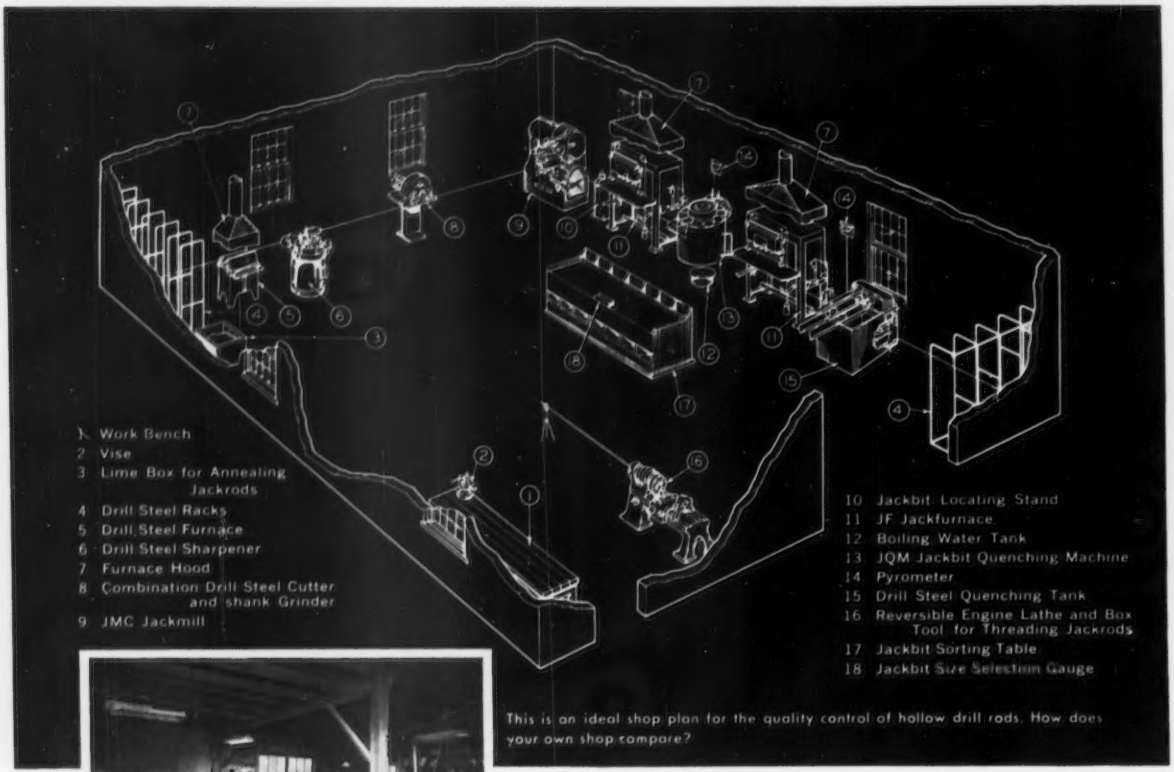
XANTHATES • DOWFROTH® 250 • Z®-200 SEPARAN 2610 • HYDROCHLORIC ACID AMMONIA • CHLORINE • CAUSTIC SODA VERSENE® • MAGNESIUM OXIDE MAGNESIUM HYDROXIDE • ION EXCHANGE RESINS AND SOLVENT EXTRACTANTS.



HERE ARE EXAMPLES of how little Separan 2610 is required: In thickening copper tailings, clearer overheads and better filtration are reported with only 0.0041 pounds per ton of solids. Similar improvements are taking place in uranium filtration at 0.5 pounds per ton.

YOU CAN DEPEND ON DOW

how to get the most out of HOLLOW DRILL RODS


1 Work Bench
2 Vise
3 Lime Box for Annealing Jackrods
4 Drill Steel Racks
5 Drill Steel Furnace
6 Drill Steel Sharpener
7 Furnace Hood
8 Combination Drill Steel Cutter and Shank Grinder
9 JMC Jackmill
10 Jackbit Locating Stand
11 JF Jackfurnace
12 Boiling Water Tank
13 JQM Jackbit Quenching Machine
14 Pyrometer
15 Drill Steel Quenching Tank
16 Reversible Engine Lathe and Box Tool for Threading Jackrods
17 Jackbit Sorting Table
18 Jackbit Size Selection Gauge

This is an ideal shop plan for the quality control of hollow drill rods. How does your own shop compare?

Typical on the job arrangement.

To bring you the best drill rods possible, manufacturers spend many thousands of dollars each year in development and testing. Crucible, for example, put more than half a hundred different alloys through their paces before CA DOUBLE DIAMOND and 4E Alloy Hollow Drill Rods proved the answer to lower cost drilling.

But to get the most out of modern drill steels, you've got to *maintain* their fine quality *after they reach your shop.*

The Answer is Quality Control

Unintentional abuse of drill steel by improper forging, machining, heat treating and other shop operations, produces a rod that is bound to give poor performance.

That's why full time supervision on operations such as these can mean longer drill life on the job:

1. Check heat treating process. Overlap heats for proper time.
2. Check furnace and forging temperatures.
3. Check annealing process to insure correct hardness.
4. Check Rockwell hardness of shanks and thread ends.
5. Check fit of bits on newly threaded rods.
6. Check location and severity of metallurgical notch.
7. Examine all rods returned from the job and determine reason for failure.

Shop control of this type actually saves money by eliminating many rod failures on the job. Personnel will be enthusiastic in reporting improved rod performance, and you'll be getting lower cost per foot of hole drilled.

Your nearby Crucible representative will be glad to supply helpful information on other phases of drill rod care and operation – or arrange for *prompt* deliveries of hollow drill rods in the sizes, grades, and types you need. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

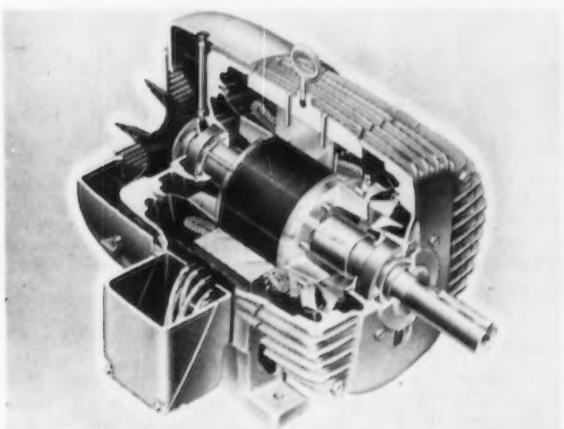
Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

James W. Franklin

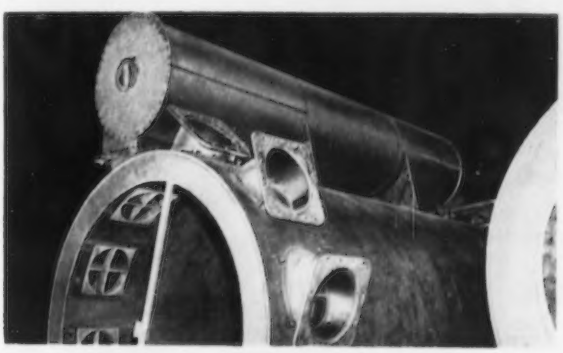
Trailer-Mounted Diesel Generating Plants Deliver 675 Kw (1)

Rated at 675 kw for continuous heavy-duty service, this complete, self-contained plant meets size and weight requirements for over-the-road movement. Fairbanks-Morse & Co. built this one shown here for the Navy, has three smaller trailer-mounted models available: 350-, 400- and 500-kw. Diesel is a six-cylinder, 962-hp, opposed-piston type in the larger unit, and a smaller version of the same opposed-piston design is used in the smaller generators.



Redesigned Motor Line (2)

General Electric Co. has completely redesigned its line of ac induction motors in the 40- to 125-hp range along the new standards suggested by the National Electrical Manufacturers' Association. This changeover completes the development started several years ago when GE converted Tri-Clad 55 motors in the one- to 30-hp range. All the Tri-Clad 55 motors offer weight savings, size and horsepower savings over previous designs in both totally enclosed (see above) and drip-proof designs.



Baffled, Tube Coolers Attach Direct to Kiln (3)

Tube-type, baffled coolers, 3- to 5-ft dia and 15 to 20 ft long, attach directly to the ends of the kiln, parallel to the kiln shell, to form a unit that rotates with the shell. In operation, cooling air is introduced into the tubes through the discharge openings and moves through the spiral baffles. Hot kiln product drops into the tubes at the other end, filling each tube to about half its volume. The hot material transfers heat to the baffles and the baffles transfer the heat to the induced air. Allis-Chalmers Mfg. Co. says that the coolers are especially designed for fine and soft material.

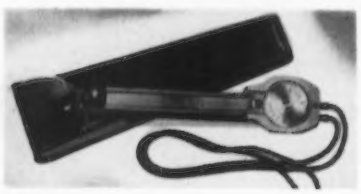
Continued on p 36—use card opposite p 42.

Portable Electromag (7)

Portable electromag is being produced on commercial scale by Central Geophysics Ltd., based on prototype devised by Frank Doolan, formerly associated with Hudson Bay Mining & Smelting Co. Unit weighs 30 lb, can be handled by two men: one to transmitter, other to the receiver. Unit consists of four pieces: an 80w battery-powered transmitter, transmitting and receiving coils, electronic receiver.

Diamond Core Drill (8)

Cradle mounted on an air leg for short hole underground coring. High-Speed Air Leg Diamond Drill can be operated by one man and requires no special spraging or bracing. Drill is powered by 10 hp, 3,000 rpm air motor and has a rated capacity of 60 ft of E rod, according to E. J. Longyear Co.

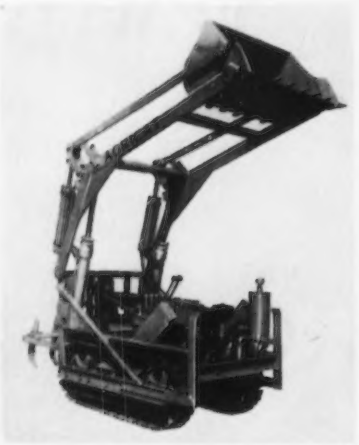


Pocket Range Finder (13)

Capable of measuring distances from 8 to 100 ft with accuracy assured within 2% this 6-in. range finder can be carried in the pocket, according to Edmund Scientific Co.

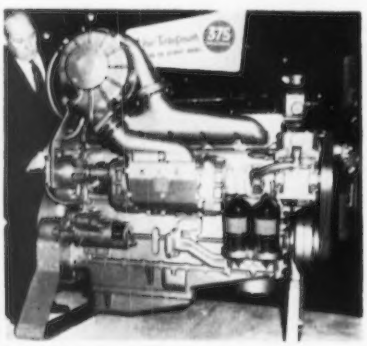
Front-End Loader (11)

One lever is used to select any of three speeds in either direction on Tractomotive Corp.'s 2-cu yd, four-wheel drive loader. TL-20D has power steering and brakes. Power is supplied by Allis-Chalmers' 100-hp diesel engine.



Light-Weight Loader (9)

Model F Agricat Loader can be converted into a bulldozer and a backhoe, according to Joost Manufacturing Co. Loader has three speeds: two forward and one reverse, and is equipped with 6-cu ft bucket. Clutch is V-belt idler type with foot pedal control. Motor is Briggs & Stratton 9-hp, four-cycle, air-cooled.

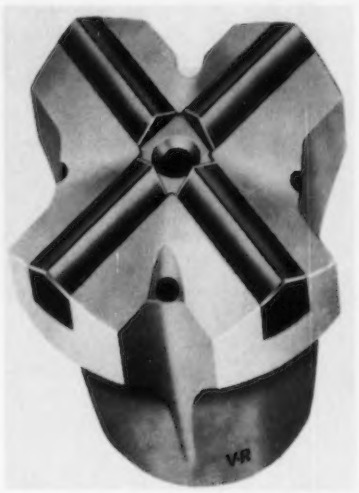


Six-Cylinder Diesel (12)

Detroit Diesel Engine Div., General Motors Corp., will show their 375-hp, 6-cylinder design at the May American Mining Congress Coal Show. Unit uses an exhaust-driven turbine and an air impeller to supplement the air supply.

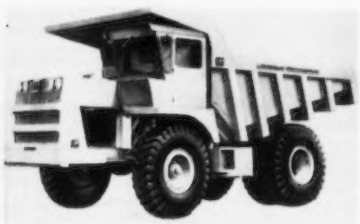
Stationary Air Compressor (19)

Heavy-duty stationary compressor from Atlas Copco Eastern, Inc. offers new savings in lower operating speed and a special heat recovery section that will convert up to 60% of total power input into hot water for space heating. Units in Copco's series range from Model AR-1 (330 cfm) to AR-9 (32,200 cfm). Compressors are L-type, two-stage, two-cylinder, double acting water-cooled machines. Maximum discharge pressure ranges up to 270 psi. Intermediate and smaller models can be skid-mounted.



X-Mounted Insert Bits (14)

According to Vascoloy-Ramet Corp., X-style bit eliminates rifling and provides uniformly round holes in hard rock. X-style is adaptable directly to type 600 and 1,000 series steels. Bits are available in 3- to 4½-in. for 600 series and from 4- to 5-in. for 1,000 series steel.



30-Ton Truck (10)

LeTourneau-Westinghouse Co.'s LW-30 has no springs, conventional axles, tie rods or exposed steerage linkages, and no chassis grease fittings. LW-30 has 128-in. wheel base, can complete a turn in 43-ft dia circle and is equipped with power steering, power brake and clutch, and a power seat. Unit uses Cummins 375-hp V-8.

Flexible Mine Cable Splices (17)

Emergency repairs or permanent splices on flexible mine machine cable from No. 8 through 4/0 are made quickly and economically with Hylink connectors, according to Burndy Corp.

Aluminum Grating (18)

Grating remains structurally sound regardless of cutouts located in any part of the panel. Aluminum grating is easily cleaned and has 79% open area, according to Klemp Metal Grating Corp.

Continued on page 39. For more information, use card opposite page 42.

Built Big for Big Hauls

EXTRA RUGGED FOR ALL ROCK AND ORE MOVING JOBS

These rugged movers are built big *all over!* Ton for ton, Kenworth end-dump trucks have greater strength for longer life and less maintenance. Engineered for more driver comfort, safety and control, these production builders are spring mounted—supply unsurpassed visibility and dime-sized turning radius. Extra rugged, their variable section frames are designed to provide deepest sections at points of greatest loading stress. Front axles are just plain big—you can't bend them! Kenworth designed, full floating rear axles are over-sized too.

Built to last—their reinforced, all-welded, box-section-ribbed steel dump bodies hold up in service. Twin, fast-acting telescopic hoists, in combination with load equalizers, provide positive stability. Stem to stern, Kenworth builds 'em big—to deliver maximum performance on the toughest jobs!

KENWORTH 801
12 cu. yds. struck—
14 cu. yds. heaped
18-TON

KENWORTH 802
16 cu. yds. struck—
19 cu. yds. heaped
24-TON

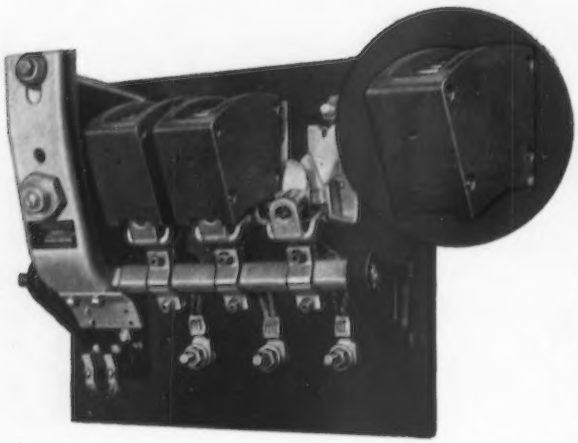
KENWORTH 802B
32 cu. yds. struck
48-TON

KENWORTH 803
24 cu. yds. struck—
28 cu. yds. heaped
36-TON

KENWORTH
MOTOR TRUCKS

FACTORY AND HOME OFFICE: SEATTLE, U. S. A., DISTRIBUTORS IN THE UNITED STATES AND MOST FOREIGN COUNTRIES

for fast arc interruption... without blowout coils

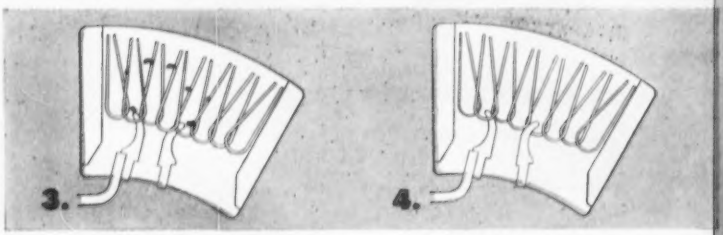


ALLIS-CHALMERS
TYPE 425 CONTROL
featuring ACBO arc-centering blowout chutes for 50 to 400 hp

The advanced electrical design of Allis-Chalmers Size 4, 5 and 6 control incorporates a modern principle of arc interruption for low voltage, high horsepower applications. The *ACBO* arc chute utilizes principles of magnetic action and thermal convection to center, rupture and extinguish the arc . . . quickly. Fast arc interruption assures maximum contactor efficiency, improves performance — greatly prolongs contact and chute life.

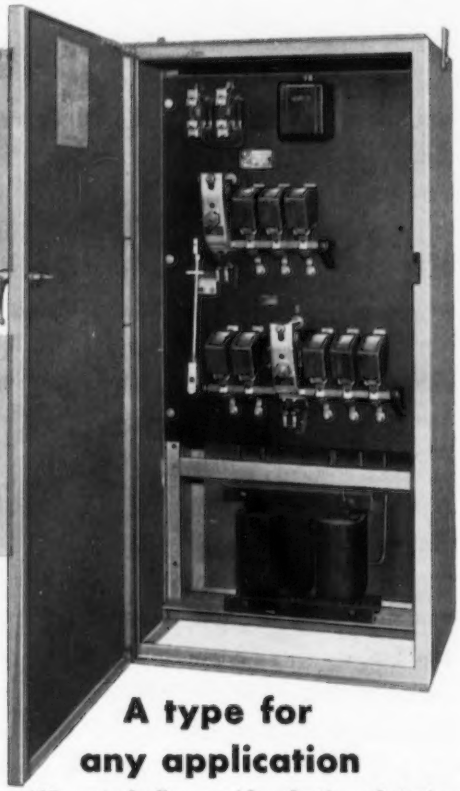
Arc across contacts as they start to open.

Strong blowout action forces arc to center.



Arc rupturing.

Contacts fully open—arc extinguished.



Simplified mechanical design

- Streamlined clapper-type construction eliminates many parts.
- Accessibility simplifies maintenance and inspection.
- Installation is fast and easy . . . sensible enclosure dimensions provide ample wiring space.

A type for any application

Type 425 control offers a wide selection of starters and contactors for any application. For detailed information, call your A-C Control Distributor or your local A-C District Office . . . or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin. Ask for Bulletin 14B8615.

ACBO is an Allis-Chalmers trademark.

A-5343

ALLIS-CHALMERS

E&MJ NEW PRODUCTS DIGEST *(Continued)*

Air-Controlled Shovel (15)

Lorain-85A, a 2½-yd shovel-crane incorporates many new comfort, convenience and safety operating features. Lorain's 2-lever "Joy-Stick" metered-air control operates all turntable movements. In addition, "Shear-Ball" mounting eliminates all types of turntable rollers, center pin and nut, according to Thew Shovel Co. Unit has two speeds in both directions, can be converted to crane, shovel, clamshell, dragline or backhoe.

Air Hammer Muffler (16)

Engineers from Thor Power Tool Co. have developed a sound-squelching muffle cover for their Model 25 paving breaker. Cover reduces air hammer noise by up to 55%. Sound-proofing material zips snuggly around hammer, effectively reduces exhaust noise and the sharp staccato clang of the piston hitting the tappet.

Mobile Compressor (23)

Air power sufficient to operate a large pneumatic tool at 98 cfm on 100 psi can be obtained with Hymatic Engineering Co., Ltd.'s Hydrovane 98P100. Unit is mobile, weighs only 576 lb. Undercarriage has two large-diameter pneumatic-tired wheels.

Corrosion Proof Valve (24)

Available in polyvinyl chloride, Teflon or 18-8 stainless steel, Chemtrol needle valves won't stick or gall and they permit precise control, while resisting corrosion from most chemicals. According to Chemtrol Corp., these valves are available in ⅛- and ¼-in. female pipe sizes and in ⅛-, ¼- and ⅜-in. male tube connections. Valves will operate at up to 170 deg F and up to 170 psi.

Mobile Radiotelephone (26)

Designed by Kaar Engineering Corp. to provide reliable long distance communications under adverse terrain conditions, this 50-watt, 2-way unit can be installed in cars, trucks, jeeps or other vehicles. TR 245 uses 1.6 to 8 mc frequency range on 6 or 12v power. Weight is 27 lb.

Dual-Shield Arc Welding (20)

New process deposits metal three to 12 times faster than manual stick-electrode welding and 33% faster than established semi-automatic methods, according to National Cylinder Gas Co. Process uses carbon dioxide gas to exclude contaminating air from the arc and molten metal, and to introduce a measured portion of oxygen directly into the weld pool where it combines with the flux.

Snake-Bite Kits (25)

Field men working alone in poisonous snake regions can be equipped with individual Saunders' snake bite kits and leather carrying cases manufactured by Medical Supply Co. Cases slip onto workers' belts and provide them with immediate snake bite treatment. Company also makes a first aid kit.

Sample Splitter (29)

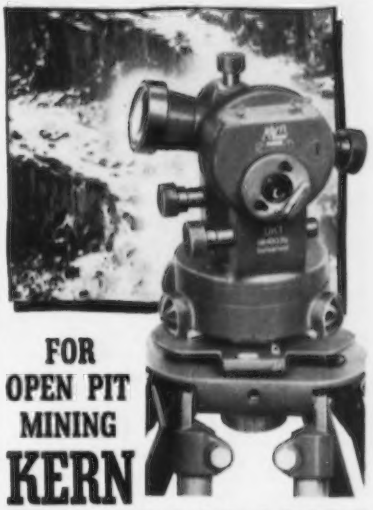
Sample splitter has top hopper with bottom discharge slot and cut-off gate. When gate is tripped, sample falls like a curtain over accurately spaced stainless steel blades. Collecting pans are aluminum alloy design. Three models available, says Carpco Mfg., Inc.

Continued on page 40.

For more information on items, use card opposite page 42.

KERN INSTRUMENTS

RIGHT for the JOB



FOR OPEN PIT MINING

KERN DKI THEODOLITE

Down-to-fundamentals design ... made for portability, rugged use ... Precision results in simplest, quickest way.

Only 6 lbs. in weight, 7" high, including carrying case.

READINGS at a GLANCE

- **Fast, effortless operation.**
- **Direct to 10', Estimation to 1'.**
- **Automatically gives arithmetic mean of two readings at opposite circle points**

FOR UNDERGROUND OPERATION

- **Illuminated Traverse Targets easily interchanged with instrument.**
- **Water and dust-proof.**
- **Exceptional clarity of optical system—50% brighter image through Kern AR coating.**

★

Write for Brochure DK 518-7

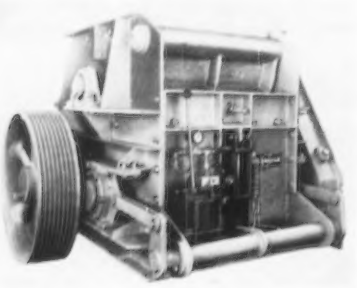
PROMPT, RELIABLE SERVICE
FACTORY TRAINED PERSONNEL

KERN and ONLY KERN OFFERS YOU the LATEST DESIGNS of **Dr. Henry WILD**

Kern SWISS

The FINEST in SURVEYING EQUIPMENT

KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.



Two-Stage Roll Crusher (21)

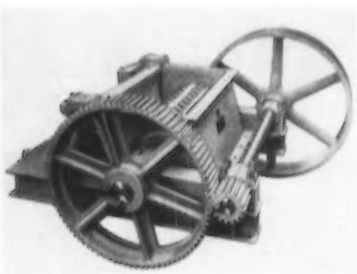
McLanahan & Stone Corp's Black-Diamond Triple-Roll crusher will take run-of-mine feed and reduce it to as small as ½-in. Unit is recommended for coal and other materials of similiar crushability. One 18-in. roll does primary breaking against a crushing plate. Two 18-in. rolls perform secondary work.

Detachable Tamping Stick (22)

Approved for safety, convenient and efficient, says G. R. Johnson Loading Supplies. Tamping rod is made of straight-grain Douglas fir with copper and aluminum alloy fittings. Stick may be used with powder screws to unload long holes. Available in 5- to 12-ft lengths. Outside diameters are 1- or 1¼-in.

All-Monel Batch Blender (30)

Intake and discharge are located at same end and machine can be loaded or unloaded while in motion. Four-way mixing action assures proper blend. Designed for corrosive or critical materials, this blender can be obtained in larger or smaller sizes as required from Sturtevant Mill Co.



Roll Crusher (31)

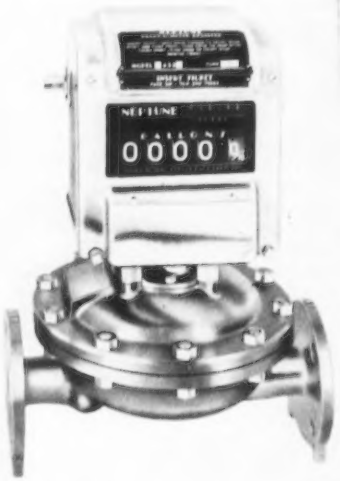
Called the Super Black Diamond by McLanahan & Stone Corp., this intermediate-duty model is intended for crushing shale, slate, gypsum, ores, mine refuse and coal. It is available with 24-in. dia. roll and in seven roll widths from 24 to 60 in.

Laboratory Magnet (32)

Stearns Ring-Type D Separator operates by passing the material through the high-intensity magnetic field produced by the rotating magnets. While Ring-Type D separator is most often used in the laboratory, it has been used successfully in metallurgical control procedures and even for small-scale commercial separations, acording to Stearns Magnetic Products, division of Indiana Steel Products Co.

Fine Grinding Pilot Plant (33)

Sturtevant Mill Co. has established a custom testing and grinding plant to operate at set-up cost and labor, and is available for test grinding in their patented Micronizer. Capacity of the units depends on mill size and material to be ground, and ranges from ½-lb to a ton or more per hour. Micronizer has no moving parts.



Stainless Steel Liquid Meter (38)

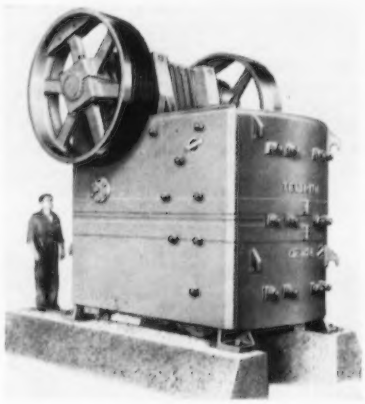
Virtually immune to chemical attack, the Neptune meter has capacity range from 20 to 100 gpm. It can be direct-reading, ticket-printing or Auto-Switch design with registers calibrated in U. S. gallon, pound, Imperial gallon, or liter, according to Neptune Meter Co.

Wetting Agent (34)

Poly-Tergent B-300 possesses outstanding wetting agent properties, according to Olin Mathieson Chemical Corp. Reagent is completely soluble in water as its cousin, Poly-Tergent G-300. These reagents show outstanding wetting and suspension action on clay and iron oxide.

Prefabricated Conveyor (37)

Joy Manufacturing Co.'s Ready-Span conveyor consists of standardized prefabricated sections of various lengths which can be bolted together in any arrangement at the site. Each section is made up of four 1½-in. pipe cords connected by ¾-in. pipe diagonals to form a laced frame truss. All accessories—idlers, walkways, cover decking, hoods, supports and special items—clamp to the pipe as needed. Drive and tail sections are adaptable for a wide variety of drive assemblies.

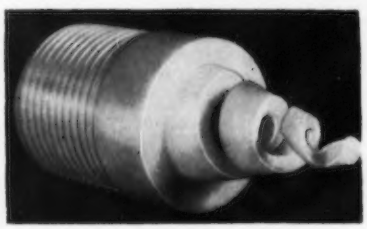


Jaw Crusher (27)

Built to be fed by a large shovel, Smith Engineering Works' newest jaw crusher has 42x48-in. opening. Unit has two-piece, double-wall, box-section, welded steel frame and a massive cast iron swing jaw.

Flocculant (35)

Burtonite V-8-F, developed by Burtonite Co., is a cold water soluble reagent that produces desired flocculation when used in 0.002% of ore weight concentration. Colloid, now available, was patented under British No. 748,212 and 748,213, with co-patents in U.S. and Canada.



Teflon Spray Nozzles (36)

Complete line of full cone spray patterns, both wide and narrow angle, made of acid and corrosion resistant Teflon are now available from Bete Fog Nozzle Inc., Greenfield, Mass. Orifices from ⅛- to ½-in. dia are available. Flow rates are from 2 to 70 gpm.

Continued opposite page 42. For more information use card opposite page 42.

Free-riding, all-rubber fillers for moisture resistance, splicing and terminating ease unusual flexibility
Special, helically-wound semi-conducting tape around each extra-flexible, stranded conductor, to prevent ionization
Butyl conductor insulation, for outstanding electrical properties, plus heat, moisture and ozone resistance
A combination of properties which permits operation with copper temperatures up to 85°C

IT'S THE EXTRAS THAT MAKE THE DIFFERENCE IN ROEBLING SH-D PORTABLE POWER CABLE!

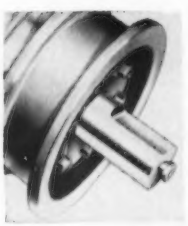
These *extra* features and others—such as the tough, abrasion- and weather-resistant Roeprene® Sheath—mean rugged, *full-power* Roebling SH-D Portable Power Cable really can stand the gaff.

If you saw this cable made, you'd know why it is so tough... and if you saw it made, you'd never specify anything else! For complete information, write Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, N. J.

ROEBLING

Distributors, Branches and Warehouses in Principal Cities

Subsidiary of The Colorado Fuel and Iron Corporation



"500" means up to 500 work hours between lubrications from new CAT* rollers. Add up the savings in service time and labor costs this feature gives you! Available for Caterpillar D7, D8 and D9 Tractors, the Cat "500" Roller also features large load carrying bearings, deep hardened ***forged steel*** rims, selectively hardened shafts and special long-lasting seals. Other makes of rollers may look like originals, but can you trust them? Be sure to get parts you *know*—from your Caterpillar Dealer.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

You can get

Positive Rotation Firing with Ignitacord®

Cut your safety fuse to uniform lengths. Cap one end and crimp an Ignitacord Connector on the other. After the holes are loaded, measure off the Ignitacord (it is color-marked at one foot intervals) and connect it to each fuse Connector so as to give you positive rotation firing. Light the Ignitacord with a match and go away from there!

The Ignitacord will burn progressively like a hot wire lighter, giving off an intensely hot flare at the zone of burning.

This flare will ignite each Connector which in turn will ignite each fuse.

You'll get a series of shots timed correctly. You'll save safety fuse. You'll enjoy greater safety, too.

This Ignitacord booklet tells the story clearly: what it is and how to use it. Write for a copy — it's free. Purchase Ignitacord and Connectors through your explosives supplier.

THE ENSIGN-BICKFORD COMPANY

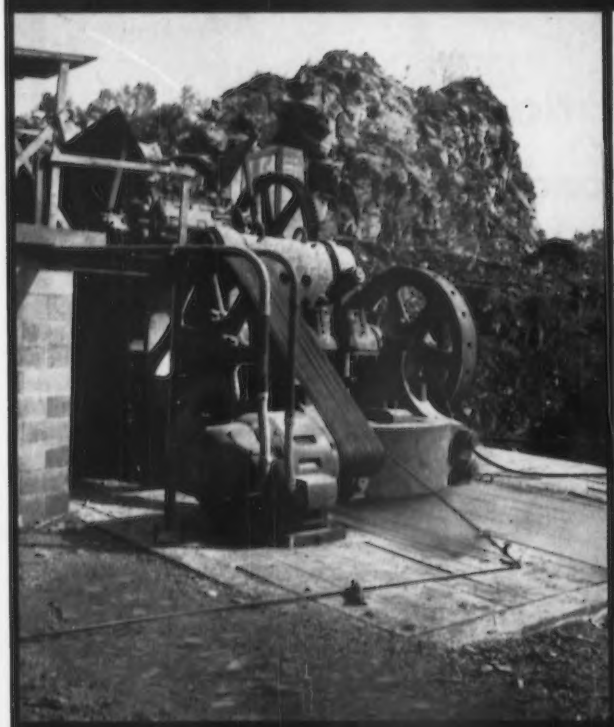
Simsbury, Connecticut • Since 1836

Primacord® and Detacord® Detonating Fuse, Safety Fuse, Ignitcord®, Quarrycord, Pyrotechnical Devices and Blasting Accessories

IGNITACORD®

and CONNECTORS

the expert fisherman
has his rod custom-made
because he gets
something **EXTRA**



the profit-wise operator

BUYS TRAYLOR JAW CRUSHERS for the same reason

For over half a century, producers have specified Traylor-made Jaw Crushers to insure extra hourly production with lower operating costs per ton. There are four types of Traylor-made Jaw Crushers to fit every primary breaking requirement. Feed openings range from 8″ x 12″ to 60″ x 84″; capacities from 4 to 1000 tons per hour. For bulletin on Traylor Jaw Crusher suited to your needs, write stating product size and capacity desired.

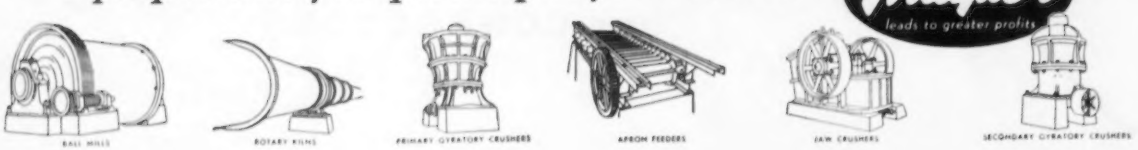
TRAYLOR ENGINEERING & MFG. CO.
941 MILL ST., ALLENTOWN, PA.
Sales Offices: New York—Chicago—San Francisco
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P.Q.

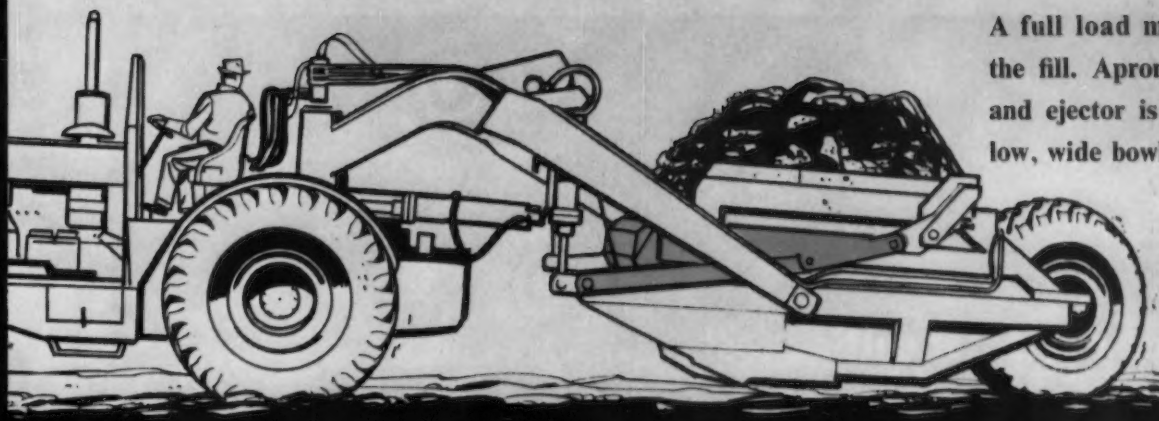
the experts agree . . . there's nothing like

TRAYLOR-MADE

equipment for peak performance

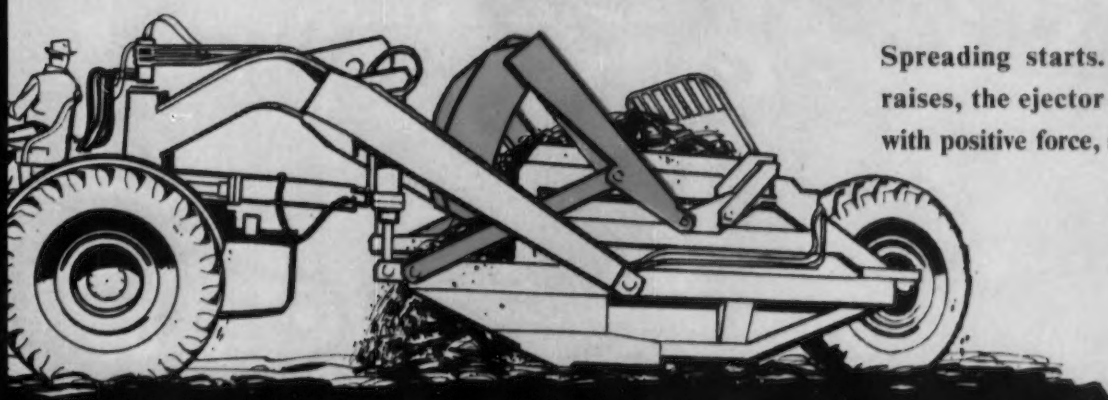
A Traylor leads to greater profits





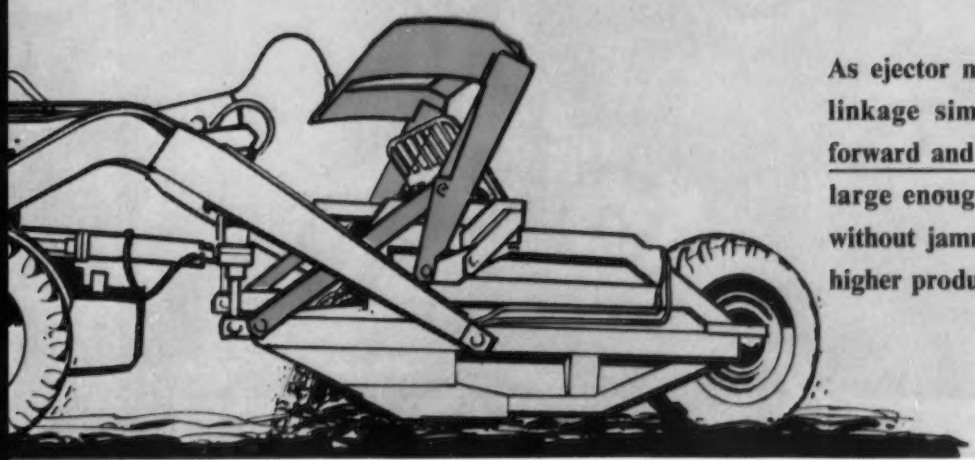
A full load moves on to the fill. Apron is closed, and ejector is at rear of low, wide bowl.

How Allis-Chalmers' patented 3-point scraper linkage



Spreading starts. As the apron raises, the ejector moves forward with positive force, accurate control.

assures fast, clean, controlled spreading of any material



As ejector moves toward cutting edge, linkage simultaneously moves apron forward and upward, providing opening large enough to let any load fall free without jamming. Result: faster cycles, higher production, more profit!

Only your nearby Allis-Chalmers dealer can offer you this important advantage. See it demonstrated now . . . on either motor or pull-type scrapers. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

Power knife for cutting costs

Coal cutters, and all other powered mining equipment, such as loaders, feeders, shuttle cars and drills, work toward the one big goal of safer, more economical production. Simplex-TIREX cords and cables are helping to achieve this goal in mines everywhere. They offer maximum flexibility, and their jacket of cured-in-lead Neoprene Armor resists abrasion, oil, heat and water, and gives longest life.

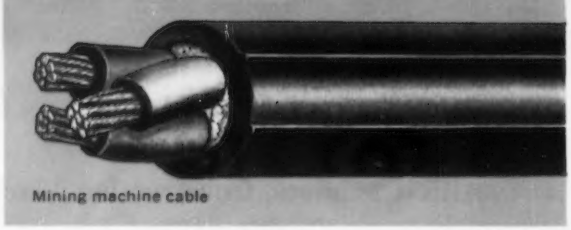
SIMPLEX WIRE & CABLE CO.,
79 Sidney Street, Cambridge 39, Mass.

Wire sculpture by Henry Szafarz

LIVE BETTER ELECTRICALLY

Simplex **TIREX**

See us at the Coal Show Booth 1607



Mining machine cable

Yes!...it's ALL STEEL

HP RANGE:
½ to 40 hp

RATIOS:
4:1—14:1—24:1 (or 20:1)

OUTPUT SPEED RANGE:
420 to 5 rpm

TORQUE RATINGS:
up to 31,000 lb-in

FALK
ALL STEEL
Shaft Mounted Drive

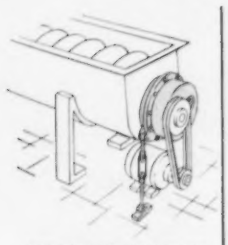
...Steel can "take it"!

STEEL frame ...of fabricated plate supports all rotating elements—provides double the ability of iron to maintain vital alignment of revolving elements, even under shock load or external impact.

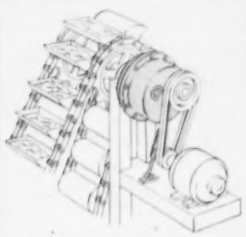
STEEL housing...will not fracture, serves only as protective cover and lubricant reservoir. Therefore, lubricant supply is safeguarded.

STEEL tie-rod and straddle-mounted tie rod brackets...are fastened to heavy steel frame by steel bolts in double shear.

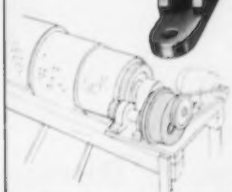
A FEW TYPICAL APPLICATIONS



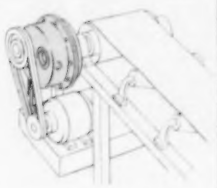
SCREW CONVEYOR



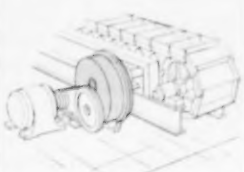
BUCKET ELEVATOR



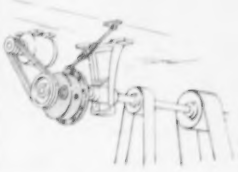
GRAVEL CLASSIFIER



BELT CONVEYOR



APRON FEEDER



LINE SHAFTING

DELIVERIES TO MEET YOUR REQUIREMENTS

Off-the-shelf delivery **from your Authorized Falk Distributor.** ***Shipment from factory or warehouse stocks*** **within 72 hours after receipt of your order.**

Write for Bulletin 7100

THE FALK CORPORATION, 3001 W. CANAL ST., MILWAUKEE 1, WIS.
Representatives and Distributors in Most Principal Cities
Manufacturers of Quality Gear Drives and Flexible Shaft Couplings

FALK
...a good name in industry

Dump in *one second* with Dumptor®

On the above operation, Koehring Dumptor drives up to the hopper, body forward. Operator trips the body-release lever, and *gravity* tilts the 6-yard body 70 degrees. One second later the load is out, and Dumptor is on its way back for the next load. Because there is no waiting for slow-acting body hoists, *gravity-dumping* saves 15 to 25 seconds on every round trip. This adds up to a substantial increase in extra yards per hour. For instance — take a typical 1,000-foot haul, where you normally would make 16 trips an hour. By saving an average of 20 seconds dump-time on each trip, Dumptor gains 320 seconds, or 5.3 minutes more productive haul-time an hour. You get 17½ trips, instead of 16. This, alone, adds 9% to hourly production. What's more, there are no expensive hoist-replacement parts, or hoist maintenance time. *Gravity-dump* never wears out, never balks. You get the same one-second dumping *every time,* under heaviest loads, in all temperature extremes. Better check what this can mean in lower costs, and increased production on your hauling operations. Get the complete Dumptor story from your local Koehring distributor. *Call him today.*

Plenty of power on the haul — You get better than 6 h.p. for every ton of loaded weight when you haul with heavy-duty Dumptor. That's why it accelerates fast, pulls through soft ground, up ramps and grades with less shifting — climbs 24% grades fully loaded. When hauling heavy materials, extra horsepower means extra load-carrying capacity.

No-turn shuttle hauling — Dumptor solves problems of operating in tunnels, along overhead trestles, or narrow haul roads. There is no need to turn, because it travels with equal ease, power and speed in either direction. No-turn hauling offers a big production advantage, too. Every turn saved cuts 15 seconds off cycle time, increases output.

Easy-loading target — Big, 64 square-foot body opening permits loading Dumptor over the side or either end. This saves spotting time, reduces spillage. Heavy duty body is built for rock. Top edge and bottom are box-beam constructed. Sides and ends are rib-reinforced. In fact, Dumptor has a ton of strength for every ton of payload capacity.

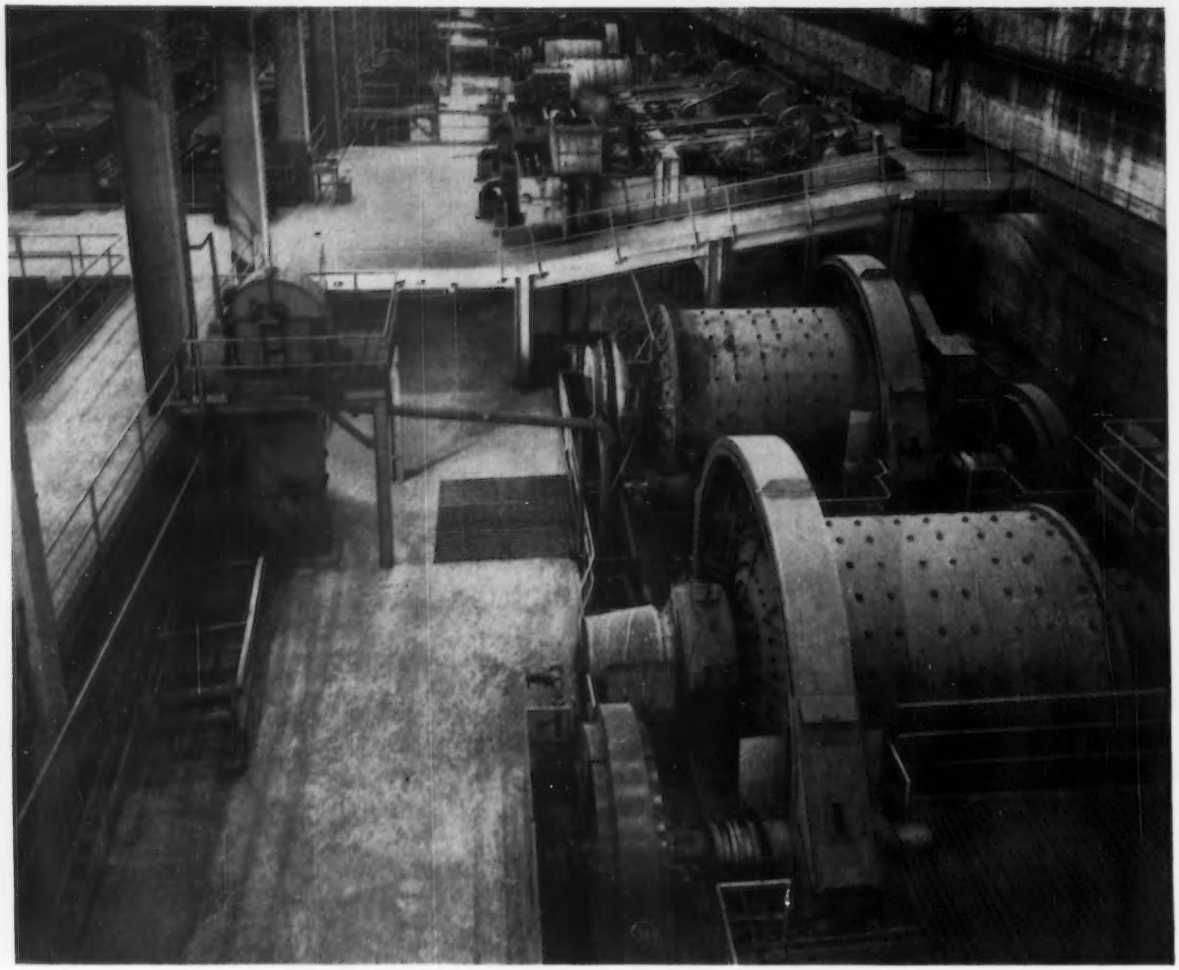
Time-saver on stockpiling — Dumptor puts stockpiling on a fast shuttle-haul basis — eliminates turning on top of pile. Notice how instant dumping action kicks the load out over edge of pile — saves a lot of dozer clean-up. Free-swinging kick-out pan breaks load suction in wet, sticky materials, bolts down to floor when handling rock.

KOEHRING COMPANY, Milwaukee 16, Wis.

Subsidiaries: PARSONS · KWIK-MIX · JOHNSON · KOEHRING-WATEROUS LTD.

KOEHRING HEAVY DUTY

K641



Ni-Hard liners save labor, cut maintenance and grinding costs by providing the utmost in tonnage life. Results obtained in our own grinding aisle show economies you can count on for your own mills.

Ni-Hard shell liners wear only .018 lb. per ton grinding more than 3 million tons of nickel ore

This high tonnage life demonstrates the outstanding performance of Ni-Hard* nickel-chromium white iron shell liners in the concentrator shown above.

Only recently, two sets of lifter bar liners were removed from rod mill service in this plant, Inco's Creighton concentrator, which began operating in 1951.

Used in large mill

The Ni-Hard shell liners served in 10′8″ x 13′ mills grinding highly abrasive nickel ores with 3″ and 3½″ rods. Mills ran at 60% of critical speed. At the discharge, solids in the slurry ran 70%. Total life in the #1 mill was 3,430,000 tons of ore; in #4 mill, 3,266,000 tons. The liners for each mill originally weighed 60,912 lbs.

This example of Ni-Hard shell liner service is a severe one . . . nickel ores are among the toughest. But the record of Ni-Hard liners in such service shows what this material can do for your grinding operations.

Where your abrasion is severe . . . use Ni-Hard liners.

*Registered Trademark

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N.Y.

50 CYANAMID 1907 1957

CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"

Liquid AEROFLOAT® Promoters-- $elective and $aving

Are you missing a chance to cut costs and improve recovery at your flotation operation by not using a liquid AEROFLOAT Promoter? Here is what one modern lead-zinc operation recently did by adopting the use of AEROFLOAT 31 Promoter:

(1) Eliminated use of lime and labor required to prepare lime slurry. (AEROFLOAT Promoters do not generally float pyrite in neutral or alkaline circuits).

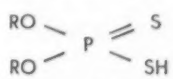
(2) Cut frother consumption in half.

(3) In the Pb circuit cut promoter consumption from 0.14 lb/ton xanthate to 0.07 lb/ton AEROFLOAT 31, and in Zn circuit cut back to 0.017 lb/ton AEROFLOAT 31 from 0.04 lb/ton xanthate.

(4) Boosted Pb recovery from 96% to 98% and Zn recovery from 78% to 86%.

(5) Saved $50 per day in reagent costs and added several hundred dollars daily in recovered metal values.

There are five liquid AEROFLOAT Promoters available, all based on the dithiophosphoric acid structure,



where R is a phenolic ring (cresol, xylenol).

AEROFLOAT 25 Promoter is the basic liquid AEROFLOAT Promoter and has limited frothing power. AEROFLOAT 15 is a slightly weaker promoter with more frothing power. AEROFLOAT 31 and 33 Promoters are fortified with strong promoters of limited water solubility. AEROFLOAT 242 is an ammonia-neutralized, water-soluble form of AEROFLOAT 31 Promoter.

If you need a selective promoter which can give you lower costs with improved recovery, why not try one of our liquid AEROFLOAT Promoters? A post card will bring you samples for testing.

AMERICAN CYANAMID COMPANY

MINERAL DRESSING DEPARTMENT

30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.

NORTH AMERICAN CYANAMID LIMITED
160 Bloor Street East, Toronto 1, Ontario, Canada

CYANAMID DE MEXICO, S. A.
Apartado No. 26012, Mexico 12, D. F., Mexico

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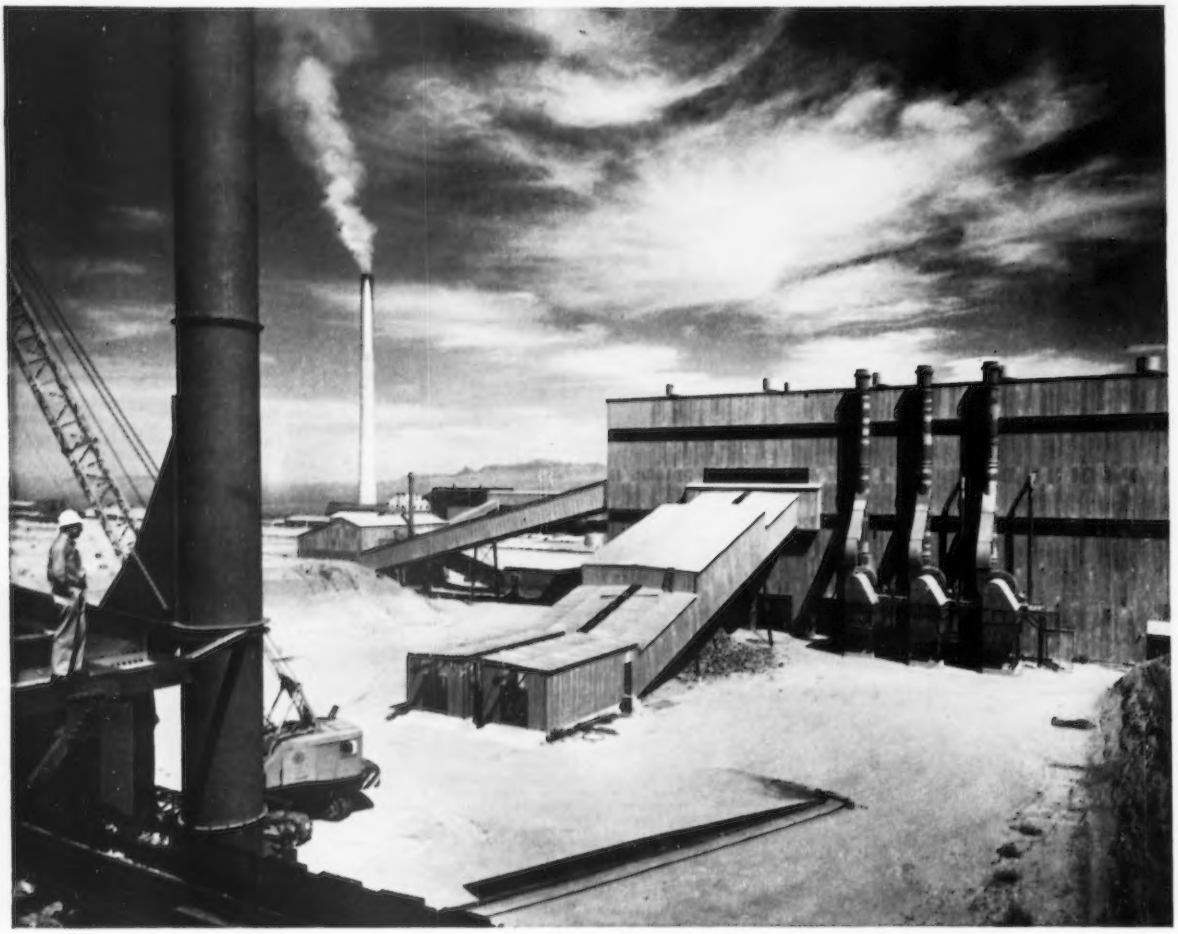


AAF ROTO-CLONES doom dust at this Southwestern copper mill

The only dust you can find around this large copper mill is that kicked up on the surrounding plain. Inside this plant (as in more than a dozen others), dust never has a chance. AAF Type N ROTO-CLONES whisk it away the very second it is created during crushing, screening, transfer and fine ore storage operations.

The high cleaning efficiency of the wet-collecting Type N results from the combined action of centrifugal force and the thorough intermixing of water and dust-laden air. Small space requirement, constant exhaust volume and maintained performance over a wide range of operating conditions—good reasons for specifying the Type N.

For complete product information, call your local American Air Filter representative or write for Bulletin 277.

AAF herman nelson

American Air Filter
COMPANY, INC.

195 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

AAF Dust Control Equipment

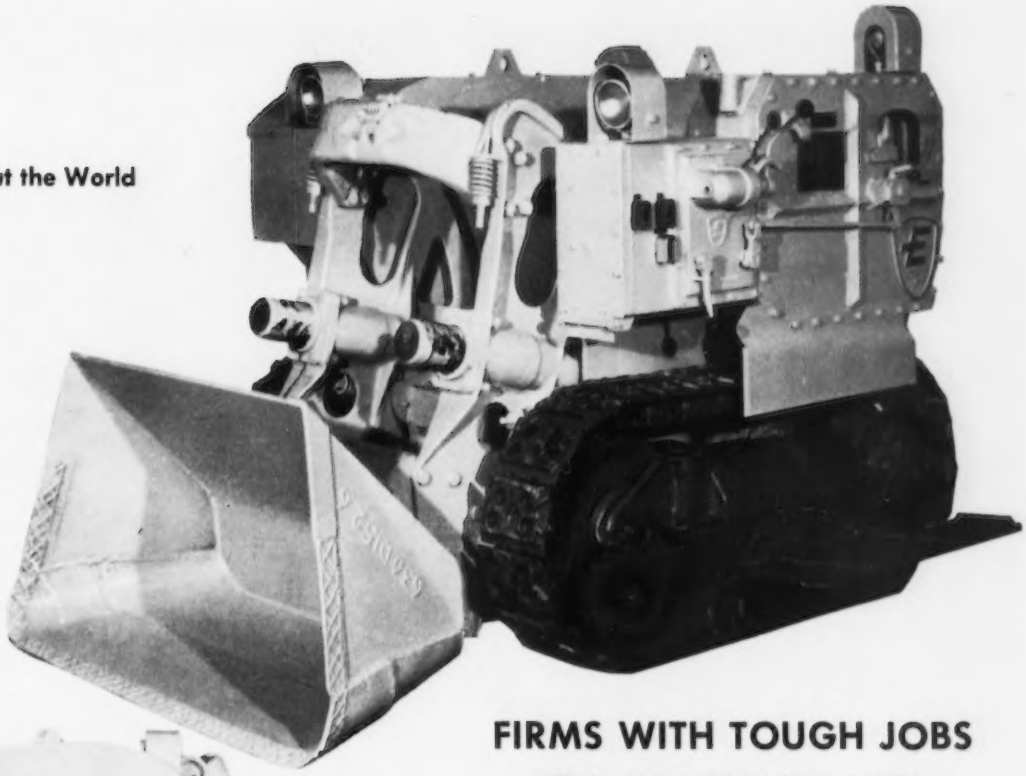
Air Filters and Precipitators

BETTER AIR IS OUR BUSINESS

Cycoil Oil Bath Air Filters

Herman Nelson Unit Heaters

Throughout the World



FIRMS WITH TOUGH JOBS RELY ON EIMCO 630's

GERMANY . . . An air powered Eimco 630 Crawler-Excavator loads loose, sticky material into Zettlemeir dumpers — 60 meters below surface — at a 260 meter conduit project that will pipe water from a lake to a large city for culinary use. Tunnel drivers expected to blast solid rock; instead, they hit soft "molasses." **REPORT:** "The Eimco handles this entire excavating chore on a 22% up-grade with ease . . . operates perfect."

GREAT BRITAIN . . . An electric-powered Eimco 630 mucks three shifts a day with its tracks submerged to the center of the front idlers in an "underground stream." Holes burned in the bucket for drainage, cascade water onto the electric motors. An electric rail mounted loader of another make was abandoned after a few months' service due to excessive downtime. **REPORT:** "The Eimco stays on the job. Mine personnel are amazed at its performance under such adverse conditions."

EASTERN U.S. . . . High in the Appalachian Mountains an Electric 630 mucks short crosscuts, cuts slopes under pillars, robs pillars, mucks high grade ore from confined areas where maneuverability and overhead discharge are essential to profitable extraction . . . and does many other tasks. **REPORT:** Quoting the mine superintendent: "Every mine should have at least one Eimco 630."

In all parts of the world, you'll find firms with tough mucking jobs relying on Eimco 630's. **FIND OUT WHY . . . BEFORE YOU BUY!**

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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B-256

How a midwest steel producer

TRIPLED TRACTOR-SHOE LIFE

It's "tough-going" in a slag pit! Heavy loads, the grinding impact of abrasive rock and metal, really put tractor shoes to the test. And that's exactly what this steel producer did.

Amsco® cast Manganese Steel Tractor Shoes were installed in place of rolled shoes. The result: *a 3-time increase in service life.* While rolled shoes had previously been replaced after one season's service, the Amsco pads lasted nearly *3½ years—a total of 3374 service hours.*

Here's further proof that Amsco Manganese Steel—"the toughest steel known"—can save you money and replacement time wherever severe impact and abrasion are a problem. Call your nearest Amsco representative, or write us direct, for further information on Amsco Tractor Shoes.

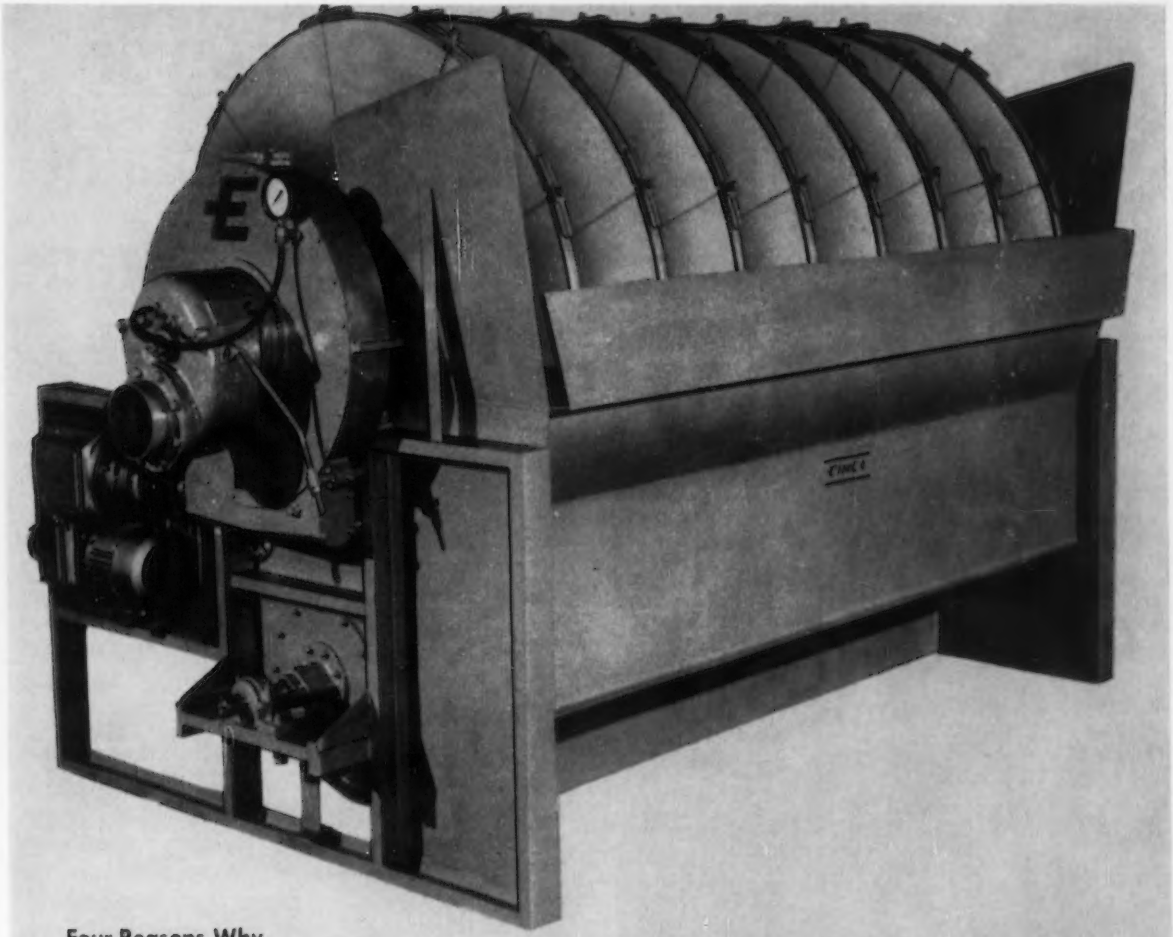
Amsco Manganese Steel Tractor Shoes
In addition to excellent impact and abrasion resistance, Amsco Tractor Shoes have countersunk bolts. This means less wear on bolts, often saves bolt-replacement when changing pads.

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DEL., OAKLAND, CAL., ST. LOUIS, JOLIETTE, QUEBEC



Four Reasons Why

EIMCO AGIDISCS SUCCESSFULLY FILTER TACONITE

Eimco Agidisc Filters — now employed by the large Taconite producers for the crucial filtration step that immediately precedes pelletizing in the Taconite Flow Sheet—are used because they get these four results vital to a trouble-free, economic operation: (1) **Close Moisture Control**; (2) **High Capacity**; (3) **Good Cake Discharge**; (4) **Low Unit Cost.**

(1) **CLOSE MOISTURE CONTROL:** Eimco Agidisc Filters send cake to the balling drums having a moisture content **within critical limits** (usually 10.2 to 10.5%) necessary for efficient, uniform pellitizing.

(2) **HIGH CAPACITY:** Eimco Agidisc Filters with **Hy-Flow** design permit high filtration rates (450 to 600 dry pounds per hour per square foot) for Taconite slurries usually about 60% solids at 80 to 85% minus 325 mesh grind.

(3) **GOOD CAKE DISCHARGE:** The Eimco Agidisc combines disc-type continuous filtration with properly directed agitation to produce a homogeneous cake, easily discharged from disc sectors. Eimco **Snap Blow** removes cake from filter medium . . . eliminates need for scrapers.

(4) **LOW UNIT INVESTMENT:** Eimco Agidiscs get more production per $ of investment, maintenance and operating costs. Close attention to detail and superior disc design, provides more square feet of filter area in less floor space. Media changing downtime is negligible. Process control and maintenance is simplified.

Eimco Clients, Eimco Field Engineers and Eimco Research and Development Technologists, have accumulated valuable data on such things as practical filtration methods . . . factors affecting moisture content . . . vacuum displacement . . and filter medium; data that now makes it possible to accurately predict filtration rates for a wide variety of conditions. **Let this experience and know-how go to work for you!**

THE EIMCO CORPORATION

SALT LAKE CITY, UTAH

Research and Development Division, Palatine, Illinois • Process Engineers Inc. Division, San Mateo, California
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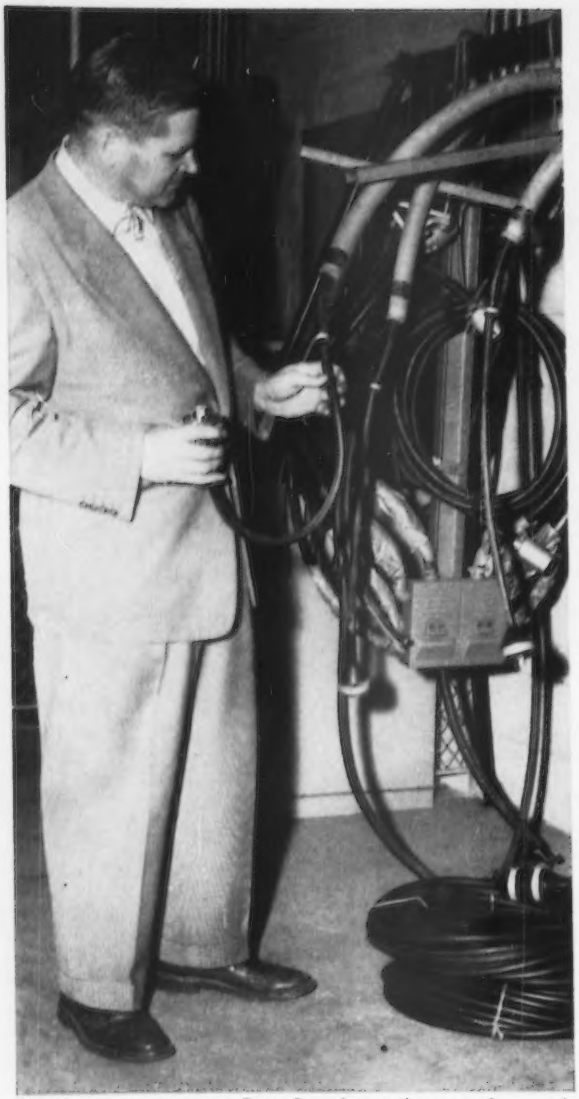
EIMCO

8-256



Mr. Maginniss inspects a Tiger Brand pigtail coming from end of a vibrator tool.

"We've never had a complaint about Tiger Brand Amerclad!"

says H. J. Maginniss, President
Maginniss Power Tool Company, Mansfield, Ohio

Here's a success story for you. In 1947, Mr. Maginniss started his company with one employee—himself. One year later, he added one more employee. Today, he has 35, and business is booming. His only product is an electric generator-vibrator system that knocks the entrapped air out of freshly poured concrete so that it is denser and stronger.

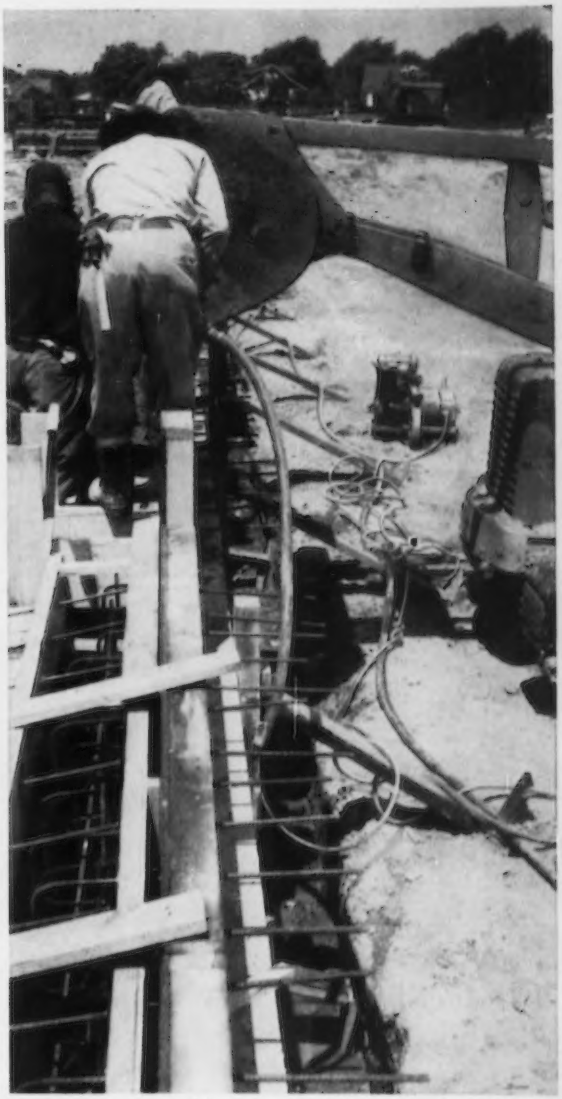
Early in the game, Mr. Maginniss learned that construction men did not exactly baby his tools. As a result, everything is built as ruggedly as possible, and that includes the cable, which is four-conductor, No. 12 AWG Tiger Brand Amerclad. Sometimes the cable drapes over several stories of scaffolding and is dragged over rough concrete, wooden beams and steel piling—while heavy trucks roll over it down on the ground. Despite all this, they have never had a complaint about the cable.

Do *you* need this kind of quality? Your AS&W salesman will give it to you!

Harry Bunton paints a vibrator. Notice heavy casing around cable near the hand hold.

Here is a cable casing that was damaged in use. Cable inside was not injured.

Workman ready to drop tool into concrete. Electric generator is on ground.



See the snarl of cable between tool and generator. Tiger Brand is made for this treatment.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

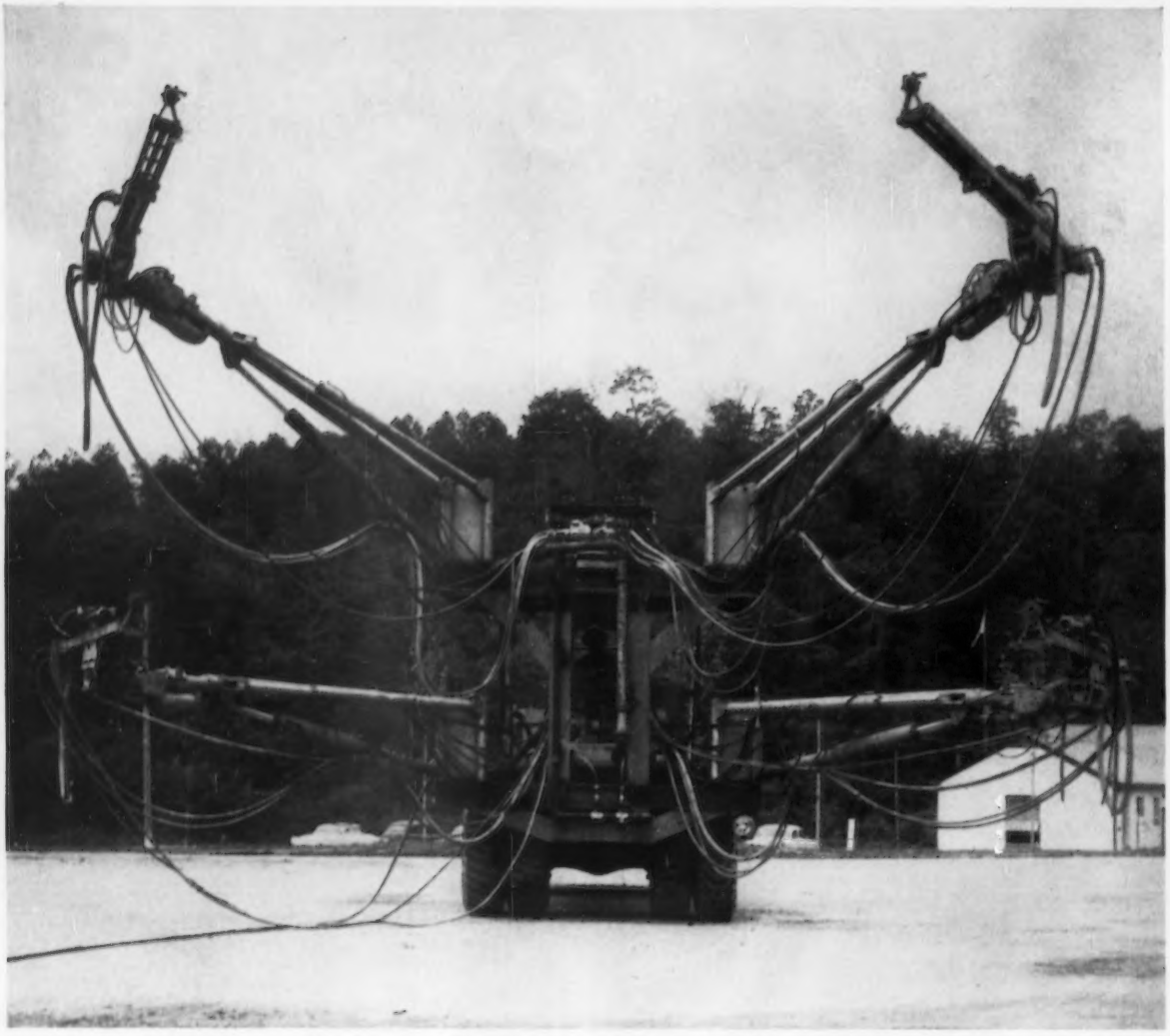
USS TIGER BRAND ELECTRICAL WIRE & CABLE

A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB

- asbestos wire and cable
- mold cured portable cord
- shovel & dredge cable
- paper & lead cable
- varnished cambric cable
- interlocked armor cable
- special purpose wire & cable
- aerial, underground and submarine cable

USS

UNITED STATES STEEL



Head-on view of a 4-boom jumbo. Note wide reach of the Gardner-Denver hydraulic booms.

Build your own jumbo with

GARDNER-DENVER COMPONENTS

Tailor your truck, tractor or rail mounted jumbo with Gardner-Denver booms, feeds and drills. You get just what you need for each dollar invested. Gardner-Denver offers a wide selection in:

- **HYDRAULIC BOOMS,** completely automatic and remotely controlled for mounting on your jumbo.
- Manufactured in two sizes and types (tunnel and rugged types), TRIPODS for mounting heavier drifter equipment with the longer chain feed.
- **POWERFUL ROCK DRILLS** in 3-, 3½-, 4 and 4½-inch sizes. Long chain or screw feed mountings.
- **SECTIONAL DRILL RODS** and couplings for long-hole drilling. Gardner-Denver Ring Seal Shank.
- **REMOTE CONTROLS** located at any point along the boom or on the jumbo chassis. With G-D Remote Controls, one operator moves booms into position and controls complete drilling operation without leaving his station.

Gardner-Denver engineers will work with your staff and powderman to design your jumbo to the job.

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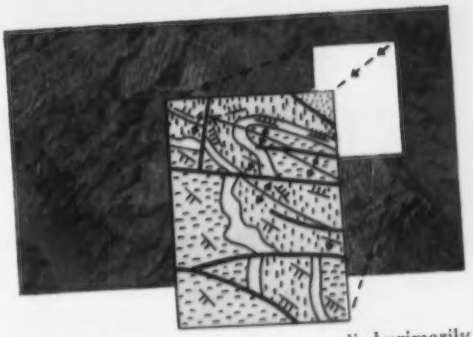
Longyear

THIS is Longyear Photogeology

In purposeful patterns, a lone plane drones over vast, unexploited reaches of a far-off land. Later, and thousands of miles away, Longyear geologists have completed geologic maps by expert analysis of aerial photographs . . . maps that say, "Look for copper in *this* area."

This is Longyear Photogeology.

The advantages of this modern, economical science are many. With his broad, three-dimensional view, the photogeologist can increase greatly the amount and quality of immediate geologic coverage. In surveys covering large areas, aerial photographs greatly reduce the costly time ordinarily required in the field. Photogeology answers rapidly many of the questions of economic feasibility of mining remote areas.



To date, photogeology has been applied primarily to the oil industry. However, Longyear photogeologists, having now applied it extensively and successfully in hard mineral exploration, recommend your serious consideration of this economical, up-to-the-minute mapping tool.

For consultation regarding the value of photogeologic mapping in your operations, call or write our Minneapolis office, or cable LONGCO.

Photo courtesy of Mark Hurd Aerial Surveys

Every mining service . . . from advance reconnaissance through mine development.

Longyear

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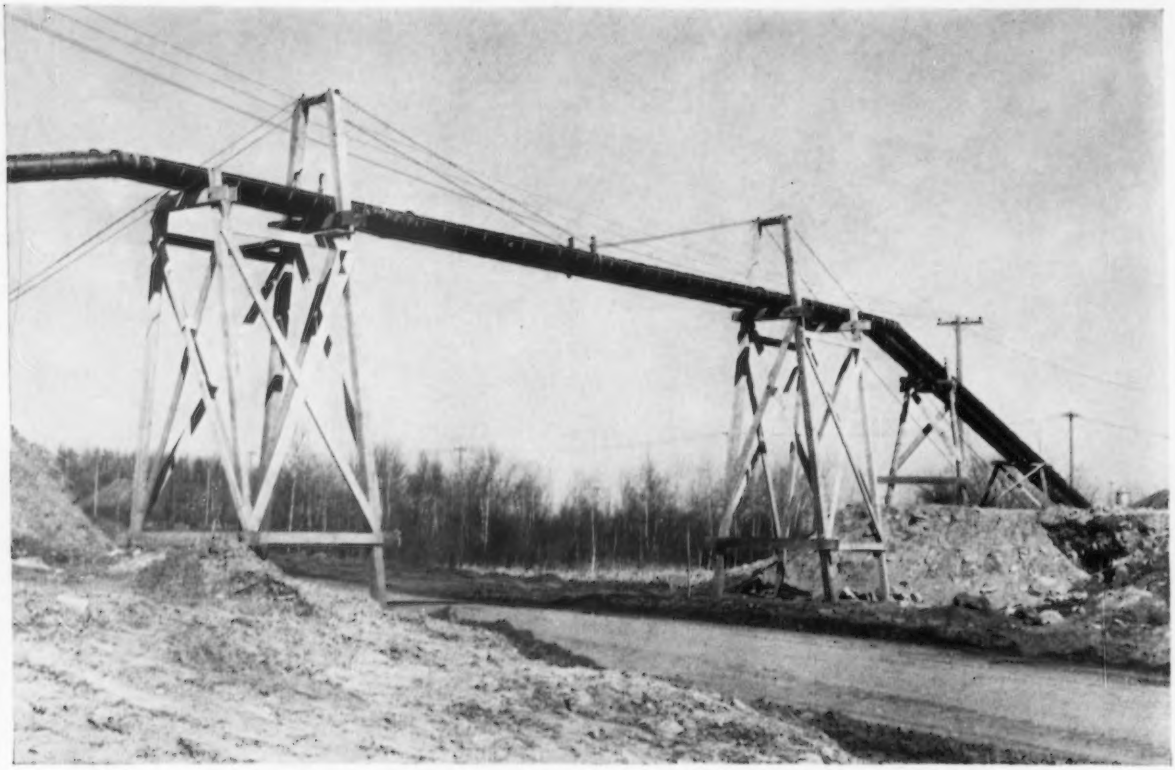
THE WORLD IS OUR WORKSHOP

Let NAYLOR PIPE Carry it for You



For uninterrupted delivery of water, air and tailings, there's no better system than lines of Naylor Spiralweld pipe.

The light weight of Naylor pipe makes it easier to handle and install anywhere—whether suspended, supported, buried or on the surface. The exclusive spiral lock adds strength not found in other pipe of the same wall thickness — to give you performance you'd expect only from heavier-wall pipe. Installation is faster, too, when Naylor pipe is joined with the one-piece Naylor Wedgelock coupling.

Put this time and money-saving combination to work wherever you need to transport material in volume. Sizes range from 4 to 30 inches in diameter.

Write for Bulletins 507 and 513.

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get maximum use of your facilities . . . with

CF&I ROCK BOLTS

You protect personnel—and mining equipment—against falls, crushes, bumps and other back, face and rib failures when you use CF&I Rock Bolts. What's more, this dependable, increasingly-popular roof support method eliminates timber supports and never blocks service openings such as airways and manways.

For your convenience CF&I offers two popular types of bolts:

Slot-And-Wedge Type—which is driven into place and has excellent load-carrying capacities.

Expansion Shell Type (with Pattin Shell)—which requires no driving with pneumatic equipment and is available in both left hand and right hand threads.

Both types can be used with Realock Chain-Link Fabric for metallic lagging as illustrated.

Ask your nearby CF&I representative for complete details on how you can use these CF&I Rock Bolts to best advantage in your own operations.

CF&I

THE COLORADO FUEL AND IRON CORPORATION

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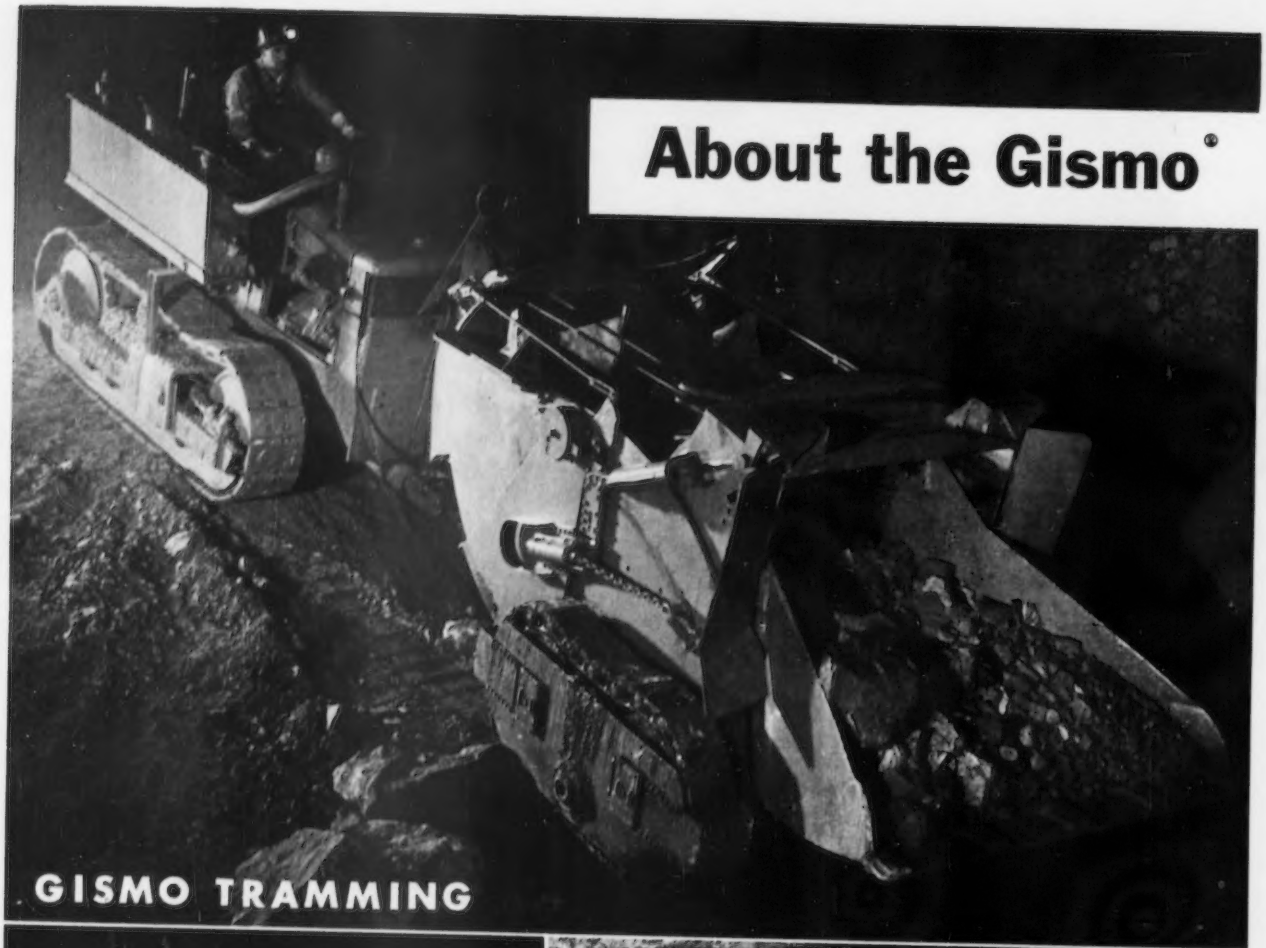
About the Gismo®



GISMO TRAMMING

LOADING

DRILLING

DUMPING / IN PRODUCTION

DUMPING / IN S-D CARS IN DEVELOPMENT

equipment— what are the facts?

Unquestionably, tomorrow's production economies and records in profitable mining operations will be the direct result of management's selection of proper equipment . . . equipment around which a simple production method can be devised. And certainly the major prerequisite to maximum simplicity is *minimum equipment, minimum labor with maximum production of both.* A plan conceived and organized by management around the criterion simplicity becomes increasingly efficient.

We believe the use of the Gismo equipment offers management the logical opportunity of devising a simple production plan. Quite successful systems organized and built around the Gismo have not only resulted in great economy in use of labor and equipment, but have practically eliminated deficiencies of time cycling operation.

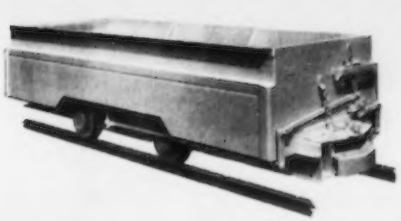
Three men with one Gismo Self-Loading Transport, one Gismo equipped as a 4-drill stoping jumbo and a Gismo tractor have produced over a long period of time in excess of 400 tons per shift. Much less stoping space was required by the Gismo method. The simplicity of the operation together with the greatly reduced manpower made it possible for supervision to practically eliminate the problem of close co-ordination and time cycling between the various departments of the mine such as drilling, blasting, loading, transporting, hoisting and general services.

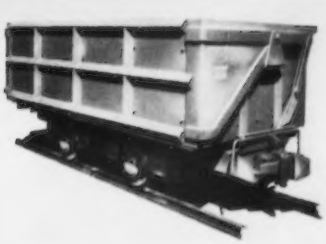
We realize producing such tonnage for so few dollars is a tremendous step forward. The natural reaction is to believe you are reading fantastic figures and statements. Nevertheless, all these facts are very true and they could mean but one thing. With the use of the Gismo equipment you are now free to organize the simple production method you have always strived for but have not been allowed to obtain because equipment permitting simple systems to function has not been available until now. *Sanford-Day Iron Works, Inc., Knoxville, Tennessee, USA*

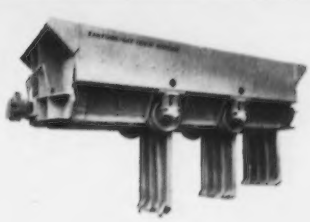
We believe it is vital for mining management to become informed on how the Gismo equipment would fit into their operation. The advantages of this tremendous step forward have resulted in some companies abandoning well set plans to purchase other types of equipment in favor of investing in the Gismo. They found upon investigation, as we believe you, too, will find, that the economies offered by the Gismo equipment and the simple method of mining it enables you to organize are far greater—entirely too great to temporarily pass off simply as a new type of equipment. In fact, so great are its potential economies that this equipment could easily mean in but a few years the difference between profit or loss.

SANFORD-DAY

"SUPER MARKET FOR MINE CARS"—all types • PRECISION WHEELS
BROWNIE HOISTS, CAR RETARDERS, SPOTTERS • THE NEW GISMO







6044

Handling materials by crane or locomotive?

Read how Pacific Northwest Alloys switched to Michigan Tractor Shovels and . . .

SAVED $5,000 PER MONTH!

THE BACKGROUND

Pacific Northwest Alloys, Inc., is a wholly-owned subsidiary of Chromium Mining & Smelting Corporation of Chicago. Their plant, located just outside Spokane, Washington, produces an alloy known as low carbon ferro chrome from African, Philippine and domestic ores. This new, fast-melting alloy is used in production of some of the new low carbon stainless steels.

THE PROBLEM

Raw materials, such as chrome ore, limestone and quartz, are stockpiled outside the plant. Formerly, locomotive cranes loaded this material into rail cars; these were moved by a switch engine to unloading hoppers. At the time, this seemed the best method of handling the new materials. Then management saw what Michigan Tractor Shovels could do! Result?

Two Michigans replace two locomotive cranes

Two of the old locomotive cranes were retired, along with most of the hopper cars. Two Michigan Model 175A Tractor Shovels now do the entire job . . . moving *several million pounds* of raw materials per month . . . saving approximately $5,000 per month! And that's not all . . .

Weather no longer slows production

The old method of plant feeding was mainly a warm-weather proposition. Raw materials often froze in the hopper cars, simply wouldn't drop—but *production* did, until Michigans were put on the job. Now, transfer of raw materials is fast *and dependable,* no matter what the weather. Despite haul distances of up to ½ mile, *one* Michigan outworks *two* railroad cranes and the large labor crew formerly used during the winter months. In addition . . .

Switching gondolas is another important part-time Michigan job. Here, a pusher-equipped Model 175A puts its four-wheel-drive and 133 hp to work, moving several 100-ton cars over a spur line to the stockpile area.

Michigans permit new sand pit operation

Pacific Northwest Alloys used to *buy* sand, have it shipped in and stockpiled. But now their Michigan Tractor Shovels have made it feasible to open a small sand pit right on Company property. One of the versatile 2¾ yard Michigans digs the plant's daily requirements (about five loads) and delivers it to the unloading hoppers. It's a one-mile haul, but Michigan's excellent speed makes a dump-truck and driver unnecessary—it's actually less costly to let the Michigan do the whole job!

Plant manager reports low maintenance costs

"We use the Michigans two shifts per day, seven days a week on all kinds of jobs," reports Ralph E. Ebersole, Plant Manager of Pacific Northwest Alloys. "They handle material varying from abrasive sand to metallurgical coke (weighing about 30 lbs per cubic foot) to dense chromite ore (weighing over 200 lbs per cubic foot)—yet maintenance costs have been very minor. Savings in both maintenance and labor are more than paying for the Michigans—and we have absolute assurance of uninterrupted production, regardless of weather!"

If performance like THIS appeals to YOU

. . . get in touch with your local Michigan Distributor. He'll be glad to arrange an in-plant demonstration that'll show you just how Michigan Tractor Shovels can improve your profit picture. Count on him, too, to recommend the *correct* size Michigan for your specific operation—there are eight basic models and 38 buckets and attachments ranging in capacity from 6 cubic feet to 6 cubic yards. Choose the finance plan best suited to your investment program, too—including the popular Michigan Lease-Purchase Plan, which lets you put one or more Michigans in your plant without laying out a penny of capital.

Michigan is a registered trade-mark of

CLARK® EQUIPMENT

CLARK EQUIPMENT COMPANY
Construction Machinery Division
2465 Pipestone Road
Benton Harbor 23, Michigan
In Canada: Canadian Clark Ltd., St. Thomas, Ontario

MAINTENANCE COSTS CUT 80% HANDLING 8,500 lb/yd ALLOY

When Pacific Northwest Alloys had another problem, they did just that . . . got in touch with their local Michigan Distributor in Spokane. This time, they sought an end to the extremely high maintenance needed on their small loaders used indoors to move low carbon ferro chrome to plant shipping tables. A 16 cubic foot Michigan Model 12B was put on trial. Today, Pacific Northwest Alloys has four of these machines. They have replaced *five* of the old 14 cubic foot loaders. Maintenance costs are only ⅕ of what they were formerly.

NOW . . . DRILL 9" HOLES WITH THE NEW

JOY 59-BH CHAMPION

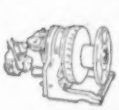
This world-famous pioneer rotary-air-blast-drill has adopted many of the features of its big brother, the Super-Heavyweight, to give you these advantages:

MORE STABLE DRILL STRING through use of round pipe . . . BETTER AIR CIRCULATION and cuttings removal . . . FASTER DRILLING—faster retraction of hydraulic feed averages total of only 3 minutes on a 51′ hole . . . EXTENDED 55′ MAST permits drilling 50′ hole without adding pipe . . . BETTER MOBILITY —hydraulically raised and lowered mast is left assembled during long moves . . . 9″ HOLE allows wider hole spacing, economical use of large diameter powder.

This all adds up to new records in low cost per ton of rock. Get the whole story on the 59-BH. Write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

Write for Bulletin 168-4

JOY . . . EQUIPMENT FOR MINING . . . QUARRYING . . . CONSTRUCTION



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PORTABLE AND SEMI-PORTABLE AIR COMPRESSORS • ROCK DRILLS • WAGON DRILLS • DRILL BITS • BACKFILL TAMPERS • SPADERS
PAVING BREAKERS • SHEETING DRIVERS • DRIFTERS • PORTABLE HOISTS • FANS AND BLOWERS • PORTABLE SAFETY LIGHTING

Consolidated Copper's new high-speed team—
large drill, big shovel, off-road truck and
mobile 27 mph MICHIGAN TRACTOR DOZER

Take a good look at the picture above. If you were at Consolidated Copper Corporation's Tripp Pit at Kimberley, Nevada, this would be about the only time you'd see their high-speed Michigan Tractor-Dozer at a standstill. And, even here, it won't be for long . . .

Michigan Tractor-Dozer's turbo-charged diesel develops 165 hp, with maximum rimpull of 28,000 lbs. Blade capacity is 2¾ yards. Powered bowl tilt and down-pressure are standard. Unit, shown here, is dozing boulders at Consolidated Copper's pit near Ely, Nevada.

Seconds after the truck leaves this waste-stripping bench, the Michigan will slip in to clean the load area. Instant, shock-free, no-clutch, finger-tip shifting between forward and reverse moves the Michigan quickly out of the way of the next truck or the shovel boom. Operator has utmost safety because he keeps foot on accelerator at all times. Visibility is excellent all-around. Power-boosting makes steering easy.

Goes anywhere at 27 mph

After the Michigan finishes cleanup here, its next call may be to another shovel, to the dump, or to clear debris from the haul road. Wherever the call, it gets there about as fast as the trucks. Top speed of 27 mph takes it half a mile, across tracks, hard-surfaced roads and trails in 1 to 2 minutes. Oscillating steering axle keeps both rear wheels in firm contact with the ground at all times. With 14½ inches of clearance, operator practically never gets hung up. And rear-wheel steering greatly reduces tire wear.

See it in action

The best way to analyze the advantages of 27 mph speed, power-shifting, and full-time four-wheel traction is to do what Consolidated Copper did—*test* a Michigan Tractor-Dozer, with your own operators, in your own pit. You pick the work . . . then time cycles, measure output, compare price per yard of dozing capacity (don't forget Michigan's f.o.b. price includes power-shift transmission, 3-to-1 torque converter, planetary wheel axles, and power-tilt blade . . . you don't have to pay for "extras" to get top efficiency).

Michigan is a registered trade-mark of

CLARK EQUIPMENT COMPANY
Construction Machinery Division
2465 Pipestone Road
Benton Harbor 47, Michigan

CLARK® EQUIPMENT

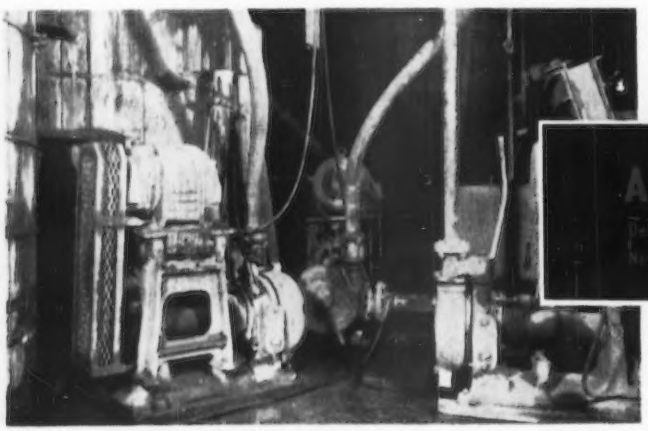
URANIUM

produced at lower costs with

WILFLEY PUMPS

WILFLEY ACID PUMPS receiving vanadium and uranium leach liquors from leach tanks and pumping them to various treatment tanks.

WILFLEY SAND PUMPS receiving the classifier overflow and pumping the material to the sand slime separation circuit.



Crucial production steps performed in today's uranium processing plants call for rugged, highly-efficient pumps. Many of these plants use Wilfley Model "K" Sand Pumps and Wilfley Model "AF" Acid Pumps . . . companions in economical, trouble-free operation.

Individual Engineering on Every Application.

Write, wire or phone for complete details.

A. R. Wilfley and Sons, Inc.

Denver, Colorado, U. S. A.

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WILFLEY ACID PUMPS

"COMPANIONS IN ECONOMICAL OPERATION"

WILFLEY SAND PUMPS

ENGINEERING AND MINING JOURNAL

MAY 1957

Why You Can't Buy, Own or Sell Gold Freely in the U. S.

AT A RECENT PRESS CONFERENCE in the chambers of the U. S. Committee on Banking and Currency in Washington, we had the unusual opportunity of asking a number of the Senators on the committee this question: "Why is it that a citizen of the United States is not allowed to buy and sell gold freely?"

Without quoting any Senator in particular, the sum of the replies and opinions received added up to this:

1. The gold in Fort Knox is essential to assure confidence in the dollar not only in the U. S., but also in the entire world.

2. We cannot safely risk any change in our gold policy at this time which will threaten to disturb the stability of the dollar—and parenthetically one of the Senators reminded us of the $273-billion debt which hangs over the heads of U. S. taxpayers.

These replies did not surprise us because they indicate that the present Congress and Administration are subscribing to the basic ideas expressed by Randolph Burgess, Under Secretary of the Treasury, in his testimony on proposed gold reserve act amendments before this committee in March 1954.

For the good of the mining industry, we would like to see an increase in the price of gold, particularly because of rising costs of mine labor and materials. But it does appear that regional and national mining organizations will have to come up with a better formula to sell the merits of a price increase in gold to the public and the Government. For years we have been going round and round telling ourselves why we ought to have a higher gold price at numerous mining conventions all over the country. But all this is futile unless we build a solid and unselfish case for gold, and then sell it to the public and our Senators.

Needed—Corrective Action, but Not in Concert

THE SKYWARD TREND of copper stocks shown in the graph on page 69 indicates that the mining industry should have taken corrective action months ago. Perhaps there is something peculiar about mining which makes it very difficult to bring production in line with consumption at an early stage to prevent some of the disturbing shutdowns that have taken place recently. In other fields such as the rayon industry or the machine tool industry you can watch periodic graphs showing deliveries and stock which appear in leading business newspapers. When stocks begin to climb and deliveries start to slump, something takes place in these industries within a very short time to balance demand and supply.

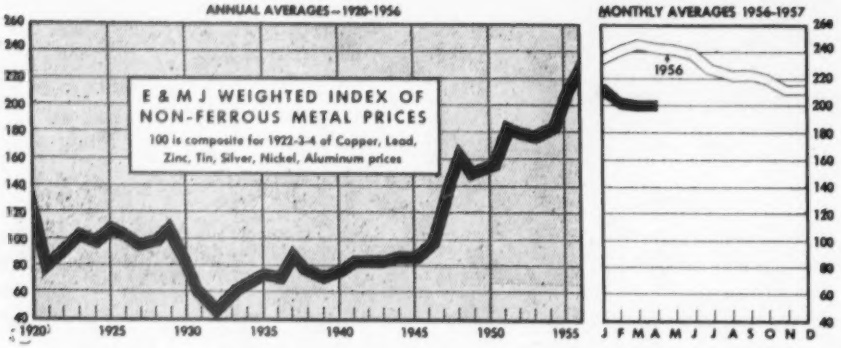
Note also in the graphs on page 69 that heavy shipments of lead and zinc went to Government stockpile during the past three years. Had it not been for these diversions and a heavy demand for lead and zinc in 1955, the bell-shaped "stocks" peaks for lead and zinc in 1954 would now be reappearing. Now that the Government is curbing stockpile buying of metals, it is time to assess the impact of this factor on future markets.

Now everyone realizes that there can be no collusive action in an industry because the Justice Department will be breathing down your neck in a hurry if they even suspect such a move. But there is no reason why an individual producer cannot study industry statistics constantly, and make a few shifts in mining operations when oversupply seems to be building up. It simply doesn't make sense to produce more and more for less and less, and deplete a valuable asset in the doing. Why not shift development work, exploration work, and open-pit stripping to periods of declining demand? Overtime, three-shift operation and other labor-cost boosters should be the first to go when metals fail to move freely on the market.

Of course all of this speculation is a waste of time if each producer says "This advice is all right for the other fellow, but I'll continue to produce at capacity." It's just as much the responsibility of each producer to help create an orderly market when demand is weak, as it is his duty to spur production when demand outstrips supply. We can't expect Government stockpiling to bail us out forever.

E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's metal price index levelled off, increasing only slightly from 203.16 (revised) during March to 203.34 for April. Copper was virtually unchanged, and tin slipped about 1/8c in the monthly averages.

What's ahead for lead and zinc stockpiling? Defense Mobilizer Gordon Gray says it will be continued "for a while." Assistant Interior Secretary Felix Wormser said stockpiling would end "in a matter of months." Commodity Credit Corp's temporary halt in barter deals for zinc of foreign origin has created a flurry in foreign lead and zinc prices, but Agricultural Department spokesmen predict that barter buying of lead and zinc "will resume soon."

Nickel production in the Free World should range between 650-million and and 675-million lb by 1961, according to estimates cited by Dr. John F. Thompson, chairman, International Nickel Corp.

●

AT HOME

Hawaii is studying what laws to enact to control strip mining of bauxite deposits now being prospected by most large U. S. aluminum firms.

New Jersey Zinc Co.'s patented process now in the pilot-plant stage can use titanium slag as a raw material to produce titanium tetrachloride for titanium manufacture instead of rutile. Quebec Iron & Titanium Corp., one-third owned by New Jersey Zinc, expects to boost titanium slag production from 195,156 tons in 1956 to 240,000 tons in 1957.

American Potash & Chemical Corp. is beginning to produce decaborane at its Henderson, Nev., pilot plant. AP&CC now markets more than 30 boron chemicals. Decaborane generates about 28,000 Btu per lb, about twice as much as coal.

Colorado Mining Association's executive board approved a proposal which would increase the size of a mining claim to one square mile. R. L. Moran, president of the Wyoming State Mining Association, says that "four-corner" staking would force the foot-prospector out of the uranium picture. Charles Steen, ace uranium prospector, also opposed this change in location regulations.

●

LABOR

Mine Mill has asked the Government to move investigation of the union's "Communist activities" from Washington to Denver. Government acquiesced.

Kicking Mine-Mill out of CIO in 1949 hasn't hurt Mine-Mill appreciably. Impotence of this punitive measure is causing CIO-AFL to think twice before they expel the Teamsters union on alleged graft charges. See p 123.

●

ABROAD

Ishara, Japan's leading chemical firm, has asked an option to purchase the entire output of a new ilmenite project on the East coast of Ceylon.

Wedexro, of Duesseldorf, Germany, has signed a contract with Tambang Tinah Bangka in Indonesia for design of a complete tin-smelting plant.

American Metal Co. Ltd., and Montgary Exploration are working on an option that will give American Metal a 60% interest in Montgary's lithium property at Bernic Lake, Manitoba.

MARKETS

Metals Weak; Barter Suspended; Long-Term Mineral Program Expected

NONFERROUS METAL PRICES rose slightly for the first time since September 1956. The *E&MJ* revised index for March is 203.16% of the 1922-1924 average; the April index is 203.34%. Tin prices were down slightly but copper rose from 31.452c to 31.517c.

Refined copper business in the U. S. has been rather steady the past six months, with the possible exception of December when it was exceptionally low. April was not significantly different from the preceding months.

Refined copper sales outside the U. S. in April were almost unchanged from March. They compare favorably with most months of last year.

U. S. copper producers held to the 32c delivered price all month but custom smelters dropped their price somewhat. But early in the month prices charged by low price sellers rose slightly —before April was over this again changed.

Foreign prices have been less stable. They rose when the strikes of late March sparked consumer buying. London had dropped to about 29¼c bid for prompt copper Mar. 22; it rose to about 30¾c by Apr. 2, dropped back to about 29.9c by Apr. 24 and on May 1 was about 30c.

Effort is being made to hold these prices. It is evident that without the relatively good buying outsde the U. S., both foreign and U. S. prices would probably be lower. At least one large producer's agent has bought heavily on London, possibly to cover a short position but some analysts say also to hold the market. But a short would benefit by further price drops so it appears doubtful both of these could apply.

Strikes that beset the copper supplying industry were settled. The Braden strike in Chile ended about the middle of April. The 30% legal wage rise was granted and also an escalator clause. Fringe benefits were included. Strike time will be applied against vacations—thus the strikers will in effect get paid for the time they were on strike. The Mufulira strike was settled early in the month.

A new smelter will be built at Papudo on the Chilean coast with capacity of 150,000 tons—presumably it will be expandable to 450,000 tons. An electrolytic refinery with 42,000-ton capacity will be built; it will be expandable to 63,000 tons.

Agreements on prices and marketing policy were hinted at in connection with some important producers outside the U. S., but few believe anything will develop in this connection.

U.S. zinc price dropped to 12c May 6. A custom smelter dropped to 12½c; another went to 12c and producers followed. Stocks had risen and continued Government price support was doubted. Smelters' net revenue will suffer less than producers'.

Zinc sales to U. S. Industry were not good in April. American Zinc Institute figures for March show no improvement over February. Shipments to the U. S. Government were the second highest on record and probably reflect mainly foreign material refined by U. S. firms. The situation is similar for lead—shipments to Government in March were much higher than in February. In spite of this, producer zinc stocks rose about 2,500 tons. Russian High Grade zinc is being sold in Europe at almost no premium over the LME Good Ordinary Brand (Prime Western) price. Polish Special High has been sold at about ⅜c over the LME.

Eagle-Picher suspended its zinc and lead mining and smelting in the Tri-State area. Inventories were rising. It produced about 9,000 tons of 70% zinc concentrates per month and about 800 tons of lead for pigments.

Zinc prices dropped in London by about ¼c on interpretation of Felix Wormser's statement in Chicago as indicating early stoppage of domestic zinc (and lead) stockpiling. Gordon Gray (head of ODM) later said domestic stockpiling would continue for a while—this is suggested as meaning it may continue through most of 1957. Rumors barter buying might permanently cease also may have contributed to the drop. Most of the $145-million remaining for stockpile from past appropriations probably will be transferred to the Agriculture Department to be used in connection with its barter program.

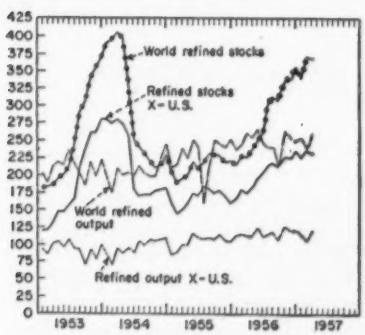
Barter is suspended until the Administration works out agriculture surplus policy —how much of what crops can be sold in what areas. Also, what can be done about objections of farm exporting countries. It is also possible the surplus will be sold abroad directly for foreign currencies, these currencies then to be used to buy foreign strategic materials. If this is done it will reduce commercial troubles much.

Wormser said in Reno barter buying will help U. S. miners—some Governors said it would over-stimulate foreign output. But some say anything that maintains prices of lead and zinc at high levels will stimulate foreign production.

Lead sales to U. S. industry were poor in April. London prices dropped for the same reason as zinc.

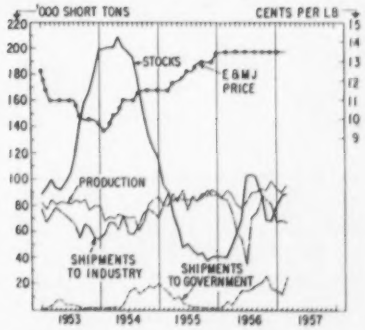
Interior is expected to announce a long term minerals program in mid-May. It will have to go through the Senate and the House. Many expect barter to be a part of it, possibly foreign currencies from barter would be used in connection with domestic mineral buying too—but this could create difficult foreign exchange problems.

Copper Production and Stocks



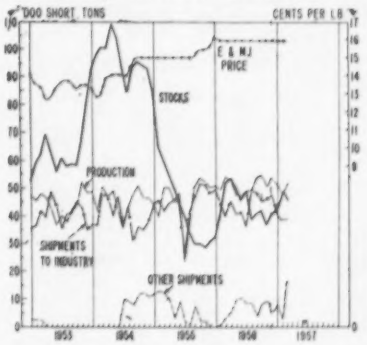
Data are from the Copper Institute and are in thousands of short tons. They include March 1957. The two series "X-U. S." are the world producer statistics less the U. S. No fabricator stocks are included

U. S. Slab Zinc



Data, except price, from American Zinc Institute. They refer to slab zinc from all U. S. primary and secondary smelters. Output from foreign ores included. Price is the E&MJ weighted average St. Louis price. March the last month reported.

Primary Refined Lead Data



Data, except price, from the American Bureau of Metal Statistics. "Other Shipments" refers to shipments to the U. S. Government. The price is the E&MJ weighted average, N. Y. Data through March.

MARKETS *(Continued)*

Average Prices April (*E&MJ* Quotations)

Copper:	
Electrolytic, domestic refinery	31.517
Electrolytic, export refinery	29.775
Lead:	
Common, New York	16.000
Common, St. Louis	15.800
Silver and sterling exchange:	
Silver, New York, per oz.	91.375
Silver, London, pence per oz.	79.869
Sterling Exchange, "Checks"	278.885
Zinc:	
Prime Western, East St. Louis	13.500
Prime, Western, delivered (g)	14.000
Tin:	
New York Straits	99.452
Gold, per oz. U. S. price	$35.000
Quicksilver, per flask	$255.000
Antimony, *(E&MJ)* (d)	36.590
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$92.692
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	27.100
Magnesium, ingot	35.250
Nickel (f)	74.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.

(a) Cadmium average based on the producers' quotations.

(b) Cadmium average based on the average of the producers' and platers' quotation.

(c) Cadmium average based on platers' quotation.

(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.

(e) Tin content.

(f) Contract price, f.o.b. Port Colborne, U.S. duty included. Other regular sellers 75¾¢ to $1.25.

(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

Transactions increased 9% in April. Coins dropped about $1.00 per ounce in most leading centers but hit a 5-year high in Paris. West Germany freed gold ownership trade and imports from E.P.U. countries. Morocco removed its gold import tax. Soviet gold sales in Switzerland totaling $17-million were reported. European trade was active. Asiatic turnovers were high especially in Djakarta and Bombay where a 7-year peak was reached. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Mar. 31	Apr. 30	Mar. 31	Apr. 30
NEW YORK, transit	.....	.....	$35.08	$35.08
MANILA	$43.50	$43.75	36.30	36.45
HONG KONG	42.50	42.25	38.05	37.95
BOMBAY	57.50	59.00	57.00	58.75
TANGIER	43.00	43.60	34.90	34.90
BEYROUTH	43.50	43.20	35.07	35.05
PARIS	44.15	46.50	36.10	36.75
BUENOS AIRES	38.75	39.35	35.30	35.60

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Apr. 1957	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	31.275	29.375	16.000	15.800	14.000	13.500	25.000	99.250
2	31.550	30.025	16.000	15.800	14.000	13.500	25.000	99.125
3	31.550	30.175	16.000	15.800	14.000	13.500	25.000	99.000
4	31.550	30.000	16.000	15.800	14.000	13.500	25.000	98.625
5	31.575	29.925	16.000	15.800	14.000	13.500	25.000	98.500
6	No Market	29.925	16.000	15.800	14.000	13.500	25.000	98.500
8	31.575	29.975	16.000	15.800	14.000	13.500	25.000	99.000
9	31.575	29.900	16.000	15.800	14.000	13.500	25.000	99.250
10	31.575	30.100	16.000	15.800	14.000	13.500	25.000	98.875
11	31.500	29.725	16.000	15.800	14.000	13.500	25.000	99.250
12	31.600	29.750	16.000	15.800	14.000	13.500	25.000	99.375
13	No Market	29.750	16.000	15.800	14.000	13.500	25.000	99.375
15	31.500	29.575	16.000	15.800	14.000	13.500	25.000	99.625
16	31.500	29.400	16.000	15.800	14.000	13.500	25.000	100.000
17	31.525	29.725	16.000	15.800	14.000	13.500	25.000	100.000
18	31.575	29.700	16.000	15.800	14.000	13.500	25.000	99.875
19	31.600	29.900	16.000	15.800	14.000	13.500	25.000	99.875
20	No Market	29.900	16.000	15.800	14.000	13.500	25.000	99.875
22	31.375	30.775	16.000	15.800	14.000	13.500	25.000	99.750
23	31.475	29.600	16.000	15.800	14.000	13.500	25.000	99.750
24	31.550	29.500	16.000	15.800	14.000	13.500	25.000	100.000
25	31.525	29.625	16.000	15.800	14.000	13.500	25.000	100.000
26	31.475	29.425	16.000	15.800	14.000	13.500	25.000	100.125
27	No Market	29.425	16.000	15.800	14.000	13.500	25.000	100.125
29	31.500	29.500	16.000	15.800	14.000	13.500	25.000	99.375
30	31.425	29.475	16.000	15.800	14.000	13.500	25.000	98.750
AVERAGES FOR MONTH								
Apr.	31.517	29.775	16.000	15.800	14.000	13.500	25.000	99.452
AVERAGES FOR WEEK								
Apr.								
3	31.330	29.621	16.000	15.800	14.000	13.500	25.000	99.354
10	31.570	29.971	16.000	15.800	14.000	13.500	25.000	98.792
17	31.525	29.654	16.000	15.800	14.000	13.500	25.000	99.604
24	31.515	29.896	16.000	15.800	14.000	13.500	25.000	99.854
CALENDAR WEEK AVERAGES								
Apr.								
6	31.500	29.904	16.000	15.800	14.000	13.500	25.000	98.833
13	31.565	29.867	16.000	15.800	14.000	13.500	25.000	99.188
20	31.540	29.700	16.000	15.800	14.000	13.500	25.000	99.875
27	31.480	29.725	16.000	15.800	14.000	13.500	25.000	100.042

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Apr. 1957	Silver (c) New York	Silver London	Sterling Exchange "Checks"	Gold London	Gold (d) United States
1	91.375	79.750d.	278.5437	250s. 7¾d.	$35.00
2	91.375	80.000d.	278.8125	250s. 9¾d.	35.00
3	91.375	79.875d.	278.8437	250s. 8¾d.	35.00
4	91.375	79.750d.	278.7812	250s. 6d.	35.00
5	91.375	79.750d	278.6562	250s. 6¾d.	35.00
6	(e)	(e)	(e)	(e)	35.00
8	91.375	79.750d.	278.7187	250s. 7½d.	35.00
9	91.375	79.875d.	278.8750	250s. 5¼d.	35.00
10	91.375	79.875d.	279.0000	250s. 3¾d.	35.00
11	91.375	79.875d.	278.9062	250s. 3½d.	35.00
12	91.375	79.875d.	278.8312	250s. 4½d.	35.00
13	(e)	(e)	(e)	(e)	35.00
15	91.375	79.875d.	278.8437	250s. 4¾d.	35.00
16	91.375	79.875d.	278.7937	250s. 3¾d.	35.00
17	91.375	79.875d.	278.8562	250s. 4d.	35.00
18	91.375	79.875d.	278.8906	250s. 3¾d.	35.00
19	Holiday	Holiday	278.8312	Holiday	35.00
20	(e)	(e)	(e)	(e)	35.00
22	91.375	Holiday	278.8437	Holiday	35.00
23	91.375	80.000d.	278.9375	250s. 3½d.	35.00
24	91.375	80.000d.	279.2312	250s. 1¾d.	35.00
25	91.375	80.000d.	279.1250	250s. 2¼d.	35.00
26	91.375	80.000d.	279.0000	250s. 2d.	35.00
27	(e)	(e)	(e)	(e)	35.00
29	91.375	80.000d.	279.0312	250s. 3d.	35.00
30	91.375	79.500d.	279.1250	250s. 2¾d.	35.00
AVERAGES FOR MONTH					
Apr.	91.375	79.869	278.885	—	$35.00
AVERAGES FOR WEEK					
Apr.					
3	91.375	—	278.774	—	$35.00
10	91.375	—	278.806	—	35.00
17	91.375	—	278.846	—	35.00
24	91.375	—	278.947	—	35.00

Calender Week Averages: New York Silver: April 6th, 91.375; 13th 91.375; 20th, 91.375; 27th, 91.375.

(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.400c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.125c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1955.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly minded domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price,. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

London Metal Exchange Quotations

Apr.	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
1	245	245¼	245⅝	246	112½	112½	112	112⅛	97	97⅛	94⅝	95	781	783	768	769
2	245⅝	246	246⅛	246½	112½	112⅝	112⅛	112⅛	97⅛	97⅝	94⅝	95	776	777	766	767
3	245¾	246	246¼	246½	112⅝	113	112¼	112½	98⅛	99	95½	95⅝	776	777	766½	767
4	244	244¼	244½	244⅝	112⅝	113	112	112¼	98½	98⅝	95	95¼	772	774	763	764
5	241½	242	242½	242¾	112½	113	112	112½	98⅛	98½	94⅝	95	771	772	762	762½
8	243¼	243½	243⅝	244	113	113½	112¼	112⅝	98⅓	98¾	94½	94⅝	775	776	765	766
9	245¼	245½	245⅝	246	113½	113⅝	112⅝	112⅞	99⅛	99½	95	95¼	774	776	765	766
10	241½	241¾	242	242½	113¼	113½	112½	112⅝	98¾	99	94¾	95	772	773	765	766
11	241¼	241½	242	242¼	112⅝	113	112¼	112½	98⅛	98⅝	94½	94⅝	769	771	766	767
12	241⅝	242¼	242½	243	111⅝	112	112	112¼	98¾	99	95	95¼	769	771	766	767
15	241	241¼	241⅝	242	111½	111¾	112	112¼	99	99½	94¾	95¼	773	774	768½	769
16	240½	241	241½	242	111¾	112	111½	111⅝	98¼	98½	94½	94⅝	773	775	769	770
17	240½	240¾	241½	241⅝	111	111¼	111¼	111½	98	98½	94½	95	777	778	771	771½
18	239¾	240	241	241¼	111	111⅛	111½	111¼	98¼	99	94¾	95	774	775	770	770½
19	Holiday															
22	Holiday															
23	239½	239¾	240⅛	240⅜	111¼	111⅜	111¼	111½	99	99¼	94¾	95	772	772½	769	769½
24	239½	239½	240½	240¾	110¾	111	111	111¼	99	99¼	95	95¼	774	775	771	771½
25	239¾	240	240¾	241	111¼	111½	111⅛	111¾	99¼	99¾	95¼	95⅜	777	778	773½	774
26	241	241¼	242	242¼	111⅜	111¾	111¾	112	99½	99¾	95½	95¾	777	777½	775	775½
29	240¼	240½	241½	241¾	110	110¾	110	110½	96½	96¾	92½	92¾	770	772	770	772
30	239¾	240	240½	241	107¾	108	108	108¼	93¾	94	90¾	90¾	770	770½	770	770½
Av'g's	£241.956		£242.788		£111.872		£111.703		£98.375		£94.669		£774.238		£768.375	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98¾ and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb. unless otherwise noted. St—short ton; lt—long ton.

MISCELLANEOUS METALS

Apr. 30, 1957

Aluminum ingot, 99 plus % lb.			27.1¢
Antimony, spot, lb. less than carload, in cases			36.59¢
In bulk, carload lots, f.o.b. Laredo			33.00¢
Bismuth, ton lots, lb.			$2.25
Cadmium, commercial sticks, delivered, lb.			$1.70
Calcium, lb. ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb contract del.			$1.29
Cobalt, 97 to 99%, per lb. eff. Feb. 1, 1957			$2.00
Germanium, per gram, 10,000 gram lots	44½¢	@	48½¢
Indium, troy oz.			$2.25
Lithium, lb. 98%	$11.00	@	$14.00
Nickel, cathodes, lb. f.o.b. Port Colborne (a)			74¢
Other sales, reg. sellers	88½¢	@	$1.345
Sales by dealers, etc.			$1.60
Magnesium, 99.8% carloads, lb. producer's plants, Velasco, Texas, eff. Apr. 16			35½¢
Palladium, troy oz.	$23.00	@	$24.00
Platinum (wholesale lots), troy oz.	$91	@	$95
Quicksilver, flask of 76 lb., 25 flasks or more	$255	@	$257
Selenium, 99 plus %, lb. (Feb. 1)			$12
Silicon, minimum 97%, carloads, lb.			20½¢
Semi-Conductor grade, lb.			$350
Tellurium, lb.			$1.65
Thallium, 100 lb. or more, lb.			$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb.			(b)$2.75

(a) Eff. Dec. 6, 1956; incl. U. S. duty; (b) Effective Dec. 3, '56.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00	@	$37.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$30	@	$30.50
48% Cr_2O_3 3 to 1 ratio	$55	@	$61
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.85(e)
Mesabi bessemer			$11.60(e)
Mesabi, non-bessemer			$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton			$201.32
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports, import duty extra, export duty included, $1.53 @ $1.57; both duties excluded, $1.395 @ $1.435. Long-term contract nominal.			
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines	$1.18	@	$1.23
Columbium-Tantalum, per lb., combined oxides 10 to 1 ratio	$1.35	@	$1.40
Tungsten Ore, per unit of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$19.25	@	$19.75
U. S. mined concentrate, per stu, f.o.b. mill (GSA price) (Suspended)			$55
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton			$84.00

(a) Nominal.
(e) Eff. 1957 shipping season.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl carload lots delivered			5½¢
Cobalt Oxide, 72½% to 73½%, per lb. eff. Dec. 1, '56	$1.52	@	$1.55
Copper Sulphate, 100 lb. eff. Oct. 25, '56			$13.90
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb of Mo	$1.38	@	$1.41

ALLOYS

Ferrochrome 65 to 70%, per lb. of Cr. (4-9% C)			27½¢
Ferromanganese, 74 to 76%, per lb., shipg. pt.			12½¢
Ferromolybdenum, 58 to 64% Mo, lb. of Mo contained	$1.68	@	$1.74
Ferrosilicon, 50% per lb. of Si f.o.b. shipping point (3-19-57)			13¢
Ferrotungsten, 72 to 82%, lb. of W contained			$2.95
Ferrovanadium, per lb. of V delivered	$3.20	@	$3.40
Silicomanganese, max. 1½% carbon, lb., contracts			12.8¢
Spiegeleisen, per long ton, 19 @ 21% grade eff. Jan. 7			$102.50

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$1,400	@	$1,725
Crude No. 2	$750	@	$1,100
Spinning fibers	$350	@	$650
Shingle fibers	$190	@	$210
Paper stock	$114	@	$137
Waste	$82	@	$84
Shorts	$28	@	$75
Asbestos, f.o.b., Vancouver, B. C. (U. S. funds):			
Spinning fibers	$470	@	$750
Shingle fibers, effective Jan. 1	$210	@	$310
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton			$16
Crude oil well grade, min. 4.3% sp. gravity, st (a)			$18
Imported, c.i.f. Gulf Ports, st	$16	@	$18
Bauxite, long ton, f.o.b. point of shipment:			
Domestic, crude, 50 to 52% (not dried)	(a)$ 5.00	@	$5.50
Domestic, chemical, 55 to 58%	(a)$ 8.50	@	$9.05
Domestic, abrasive, 80 to 84%	(a)$18.00	@	$18.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, dep. on grade			$7.14
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37	@	$41
60% effective CaF_2	$33	@	$36.50
Acid 97% concentrate, bulk, ton (eff. 12-1-56)			$50.00
Some sales at			$55
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$40.00
Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb. according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap, $25 and up.			
Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, per lt, f.o.b. U. S. mines: bright			$26.50
dark			$25.50
Mexican, per lt, f.o.b. mines, dark, 280 pesos			$22.40
Talc, f.o.b. works, ton:			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a)Some restricted sales at $11.50. (b) Corrected.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$64.50
Steel, f.o.b. Pittsburgh, billets, net ton			$74.00
Structural shapes, Pa., Ala., etc., 100 lb.	$4.85	@	$5.00

THIS MONTH IN MINING

Ungava Project Strides Ahead; 7500-Mile Survey Is Underway

THE STARTING GUN has been fired in "Operation Ungava's" race with time and the elements. Spartan-Canadian Aero Service has completed the aerial photography segment of their $400,000 airborne photographic and electromagnetic survey of the 7500-sq mile area between Cape Smith and Wakeham Bay in the northern Ontario area.

With the photographs, Spartan-Canadian Aero has now begun mapping the course for two Anson aircraft which will conduct the detailed EM survey, flying only 500 ft above the frozen Ungava barrens. The snow-covered, undifferentiated terrain presented a challenge to the geophysical teams. Area will be explored at a quarter-mile interval and preliminary maps compiled in the field and delivered to the participants.

The first sponsors for the survey are centrally located, and their areas will be probed by the McPhar-designed instrument first, with the two aircraft working simultaneously toward the east and west limits of the area. The instrument is a single, ultra-low frequency system, recording the out-of-phase signal. The bird trails some 50 ft below the plane.

At first results, each participant will receive maps only of his own area. At the conclusion of the over-all survey, all participants will receive maps of the entire survey area.

Canadian pilots, mechanics and electronic specialists are working round the clock at the bulldozed ice strip which is headquarters for the surveying company. Flying is on a double-shift basis to get all the use of the nearly 24-hour daylight possible. The ice will be gone by June 15.

Mining companies involved in the air survey (*E&MJ*, April 1957, p 73) include American Chibougamau, Area Mines, Asbestos Corp., Baska Uranium, Belcher Iron, Belmont Mining, Bornite Copper, M. J. Boylen Engineering, Central Patricia Gold, Consolidated Zinc, Consolidated Discovery, Conwest Exploration, Dome, East Sullivan, Falconbridge, Le Mine Faucon, Lemoyne Ungava, Mid-Chibougamau, Martin-Bird Gold, Mining Corp., North American Rare Metals, Noranda-Iso Uranium, O'Brien Gold, Perron Gold, Peruvian Oil, Raglan Nickel, Stadaconda Mines, Strategic Materials, Tazin, Cyrus Eaton interests, L. H. Timmins interests and Murray Watts associates.

Jones Outlines Uranium Today

WITH THE UNITED STATES "no longer faced with uranium shortages" the Atomic Energy Commission is engaged in a review of its domestc operatons "in the light of these changed conditions" according to Allen E. Jones, manager of the Grand Junction Operations Office of the Commission.

Mr. Jones told the 250 persons attending the April 5-7 uranium section meeting at Moab, Utah, of the American Institute of Mining, Metallurgical and Petroleum Engineers, that:

1. In some cases, milling of uranium ore on the Colorado Plateau was exceeding mine production, although in general the two are about in "balance" at this time. Uranium processing plants are now treating 3,250,000 tons of ore annually in the U. S., he said.

2. It is now AEC's domestic objective to provide market for ores through private milling contracts so as to effect a speedy and orderly transfer "from a guaranteed ore price to a guaranteed concentrate price in 1962."

"The operation of ore-buying stations and the accumulation of ore stockpiles in excess of current mill requirements no longer can be justified on the basis of military emergency," he emphasized.

This is why AEC closed the Marysvale, Utah, buying station and the Globe, Ariz., stations, he said, in view of existing mills with stations serving the mine districts.

White Canyon, Utah, station will be closed in a few months upon completion of the Texas-Zinc Minerals Co. Concentrator at Mexican Hat, Utah, he added.

3. ". . . The Commission is not interested in competing with private industry to accumulate (ore) stockpiles," as "we told one firm recently during negotiations for renewal of an ore-purchase contract for Monticello" mill operated for AEC by National Lead Co.

Mr. Jones said that existing ore contracts for Monticello would be honored to their expiration date but that Monticello would not buy any ores in excess of feed requirements for the concentrator.

(In this discussion, Jones formally raised the question of the future disposition of the AEC-owned and recently expanded Monticello concentrator. Several months ago, the AEC obliquely denied a report that the future of the mill was being reviewed.)

Mr. Jones said of the Monticello mill that "in the future the Commission will provide only a limited market for shippers in the general area since the Commission is providing a market for these ores through concentrate purchase contracts wth private plants, such as Uranium Reduction Co., at Moab; Union Carbide (Slick Rock, Colo., Green River, Utah); Vanadium Corporation of America (Naturita and Durango); the new Texas-Zinc mill at Mexican Hat and Vitro (Uranium Corp.) at Salt Lake City."

Among principal shippers to the Monticello mill is the Cord mine recently acquired from E. L. Cord interests by Jen, Inc.

4. The AEC is rapidly liquidating existing Government-owned ore stockpiles —"Arrangements have been made with contractors operating existing mills, and mills scheduled for completion within the next year and one-half for the recovery of uranium concentrates from Government-owned ores now in stockpile," he said.

5. Although private industry "is showing greater interest (in recent months) in exploring the possibility of applying upgrading methods to uranium ores in an effort to reduce excessive ore haulage costs. . . it has become increasingly apparent that almost no two cases of application present similar economics . . . although we believe the upgrading of ores at the site of a deposit may have application in the industry.

"In most cases, the recovery of uranium from the ore in the upgraded product has only approached 70%, and the unfavorable metallurgical characteristics of the ore have been concentrated in the up-graded material, making it less desirable for plant feed than raw ore or a similar grade.

"Metallurgists say 'the sand in an ore goes for a free ride in nearly all chemical finishing plants and it is the slime material in an ore that calls for the most expensive equipment in these plants.'

6. "The Commission has not purchased and is not contemplating the purchase of any uranium products from upgrading plants at any of the Government-owned buying stations, principally because the physical characteristics of such material make it unsuitable for stockpiling."

Jones urged those considering construction of up-graders to investigate the markets before spending their money.

7. ". . . It would not be in the Commission's interests to modify existing concentrate procurement contracts to permit concentrating of ores and shipping the product to a distant finishing plant, when these ores can be processed into a specification product at a lower cost (to the Commission) in the area where the ore is mined."

In this, he appeared to rule out proposals for chemical upgraders in the Gas Hills-Crooks Gap districts of Wyo-

(Continued on p126)

Reynolds Signs Lease For Jamaican Bauxite

REYNOLDS METALS Co. and its wholly-owned subsidiary, Reynolds Jamaica Mines Ltd., recently signed a contract with the government of Jamaica establishing bauxite royalties and taxes for 25 years and guaranteeing the right to mine the ore for 99 years.

Under the agreement, Reynolds will pay a royalty to the Jamaican government, as owner of the minerals, of three shillings a long dry ton on the first 2-million tons shipped each year and two shillings on the excess above 2-million tons (a shilling equals 14c). According to W. L. Rice, president of Reynolds Jamaica Mines, the company plans to ship at a rate of more than 2-million tons this year.

Mt. Isa Mines Locates Promising Lead Deposit

AN IMPORTANT LEAD DISCOVERY has been made in Queensland, Australia, by Mt. Isa Mines Ltd., which is controlled by American Smelting & Refining Co.

The discovery was made about 400 miles northwest of Mt. Isa town and results so far indicate highly encouraging lead mineralization at and near the surface. The outcrop now has been delineated by surface trenching and is about 400 ft long with an average width of 120 ft containing about 10% lead. A prospecting shaft has been sunk to 60 ft and a crosscut from the bottom of the shaft advanced about 70 ft in material in excess of 10% grade.

Sinking of additional prospecting shafts and crosscutting will be continued to delineate the mineralization at the 60-ft horizon. The wet season is limiting activities but diamond drilling will start as soon as the climatic conditions permit with the view of ascertaining the depth of the deposit.

Mining Calendar

Geological Society of America, Southeastern section, Morgantown, W. Va. May 16-18

Uranium Institute of America annual meeting and mill symposium. Denver, Colo. May 17-18

33rd Annual Conference, Lake Superior Mines Safety Council, Duluth, Minn. May 23-24

Spring Meeting, Central Appalachian Section, AIME. Maple Shade Inn, Pulaski, Va. May 24-25

Second Reactive Metals Conference, Southern California section, AIME, Los Angeles, Calif. May 28-29

Idaho Mining Assn. Sun Valley, Idaho. July 15-16

1957 Metal Mining and Industrial Metals Convention, AMC, Salt Lake City, Sept. 9-12.

As We Went to Press . . .

Increased smelter capacity has been attained at National Lead Co.'s Puerto Villelas smelter in Argentina with addition of lead, zinc and copper concentrates from the company's new mine and mill at Castano Viejo, perched on the bare spine of the Argentine Andes. The mill built at the mine site by Southwestern Engineering Co. turns out 250 metric tpd. Mine is 1,000 miles by truck and train from the smelter.

Construction plans are started for a $9-million uranium mill in the Ambrosia Lake area of McKinley County, N. M., by Homestake-Sapin, formerly Homestake-Sabre-Pinon Partners.

Contract for the mill was signed April 23 with AEC's Grand Junction office, calling for a 1,500-tpd mill to treat area ores. Homestake is committed to a total of $117-million for mill construction; mine development; stockpiling facilities; general financing. Sabre-Pinon brings 5-million tons of "proven ore reserves" according to treasurer Hugh M. Craigie.

Agreement to cover the Homestake-Sapin mill, which is due for completion in about 14 months, is the second negotiated for the Ambrosia Lake area. In December, AEC announced signing of a similar contract with Homestake-New Mexico Partners.

Rio Tinto Mining Co. has paid $700,000 for mineral rights to the Empress Nickel claims in Southern Rhodesia. Drilling will begin in the next few months.

Ore tested to date at the pilot plant which Rio Tinto has built indicates a nickel sulphide orebody with copper. Purchase was made from Mrs. M. M. J. Leslie, widow of the discoverer.

Construction of a processing mill and auxiliary equipment of mining of titanium on the Florida coast have been completed by Union Carbide & Carbon Corp. Construction of facilities will be underway shortly with mining anticipated in the spring of next year.

Deposit is located on 30,000 acres of Amelia Island, northeast of Jacksonville. UCC has been drilling the deposit for the past two years, proving ilmenite, rutile, zircon and monazite. A bucket-ladder dredge will take 500 tph and wet concentrate aboard the hull itself. Heavy mineral concentrate will be transferred ashore and trucked to a dry mill for electrostatic and magnetic separation. About 15 tons of concentrate will be recovered each hour. Concentrate from the three-shift, seven-day-a-week operation will eventually be made into sponge by Electro Metallurgical Co.

Iron ore deposits to "rival the Ruhr" have been reported located along the B.C.-Alberta border by Premier Steel Co. B. A. Lindberg, director of the School of Commerce, University of Alberta, says the steel company has surveyed deposits in the area between Hines Creek and the Clear Hills Mountains averaging "more than 50% purity and exceeding 1-billion tons in volume."

Cia. Minerales Santander will spend $1.5-million to develop lead-zinc-copper-silver deposits at the headwaters of the Chancay River in Peru. Company, 60% St. Joseph Lead Co. and 40% Heller-Rosenshine interest, has proven substantial reserves and will mine about 2-million tons by open pit and the rest by underground methods.

Behind the By-Lines...

G. P. Lutjen

Break out the slide rules, men, this an engineering issue; facts and figures, whys and hows from block caving at Deep Ruth to a gold mine in Africa with intermediate stops to give you the low down on a recently developed magnetometer, and all the information you need to select your own conveyor. And if we ever write another sentence this long we'll probably be fired.

It has always seemed paradoxical that gold mines should so often take a leading part in the assault on rising mining costs. Of course there's no real paradox about it. When you're squeezed between a fixed price for your product and climbing wages and material costs, it's only logical that you'll be one of the more enthusiastic (or perhaps "desperate") cost cutters for miles around. The seeming paradox is that gold has always been so strongly associated with conservatism while the measures the gold mines take are often so radical—at times, downright revolutionary.

This month we've got articles about two gold mines which have taken healthy and effective swings at rising costs. First there's South Dakota's Homestake with some new ideas in its mining and milling practices (see p 91). Then we have Southern Rhodesia's Dalny mine with a new approach to its metallurgical problems (see p 98).

Between them, these stubborn gold miners might furnish you with a few cost cutting ideas you could use right now.

If things are halfway organized this month, there should be a photograph of our newly won trophy somewhere in the vicinity of this copy. The award (the colors are Blush Pink and Mighty Blue) was made for the penetrating analysis of the zinc industry which appeared here last month—a pithy monograph setting forth a dynamic one-point program for giving zinc clouds silver linings. The impressive presentation ceremonies took place before a two-man throng on an elevator somewhere between the second and fifth floors of the Mining Club (Downtown Branch) on the evening of April 11.

Modesty forbids aught but a brief mention of the acceptance speech. It included a clarion call (on a zinc bugle especially designed for the purpose) to zinc men to galvanize the industry into action; a scathing attack on all metals that have the brass to encroach on zinc markets; and finally a motto to be die-cast in the hearts of all true believers—"Think Zinc!"

When a man gets to be a knight-commander, he can't fool around; he's got to lay it on the line.

Meanwhile at the Uptown Branch of the Mining Club in the heart of midtown Manhattan, the habitués are on a literary kick. We get the impression that hardly a lunch goes by without a glittering contribution to the fickle art of poetry. Here's a sample recently smuggled out:

There was a geologist named Steen,
Who was down to his very last bean,
  Though his uranium theory,
  Made his colleagues quite weary,
Now he's worth more than Merrill Lynch, Pierce,
  Fenner, and Beane.

Don't look at *us*, Charlie. You neither, Beane.

Do you like to hunt or fish? If you do, it is quite probable the Interior Department knows a great deal about why, when, where and how you do it. The Department last year engaged 300 opinion-takers to determine the fishing and hunting habits of Americans in 1955.

As a result of this study they have produced a 50-page, slick paper, profusely illustrated pamphlet which describes how many persons went fishing or hunting, how long they fished or hunted, how old they were, how much they spent, how far they traveled, but not how many fish they caught, or birds and animals they bagged.

According to the Survey, 25-million persons over 12 years of age went hunting or fishing; they spent $2,850,-979,000; they traveled 10.4-billion miles by automobile; it took them over half a billion days; and two out of three fishermen and five out of six hunters bought licenses.

This information will undoubtedly be invaluable to sportsmen.

But what the pamphlet doesn't show is that the Survey cost the American taxpayer a mere $200,000 plus the cost of printing.

We plucked this bitter item from the April issue of *Taxpayer's Dollar*, a publication of the Chamber of Commerce of the United States.

We goofed last month and hardly had the ink dried when we received our come-uppance, a semi-hysterical note on the back of an old E. J. Longyear bulletin, from at least two people. To assure our penance we are publishing the communication herewith, using italics to distinguish one author from the other.

Behind the Bylines for April, you speak of of an upstate New York Lead mine.

Tell G. P. Lutjen not to be misled by the lead-bearing name of the leading ZINC mine in upstate New York.

and a leading zinc mine in the country — possibly "the" leading hole in the ground for zinc.

1956 Mine Production of Zn by States

#1 Montana 71,865 tons (several shafts at Butte)

#2 New York 58,589 ton (49,100 from #2 shaft at Balmat)

#3 Idaho 46,483 tons

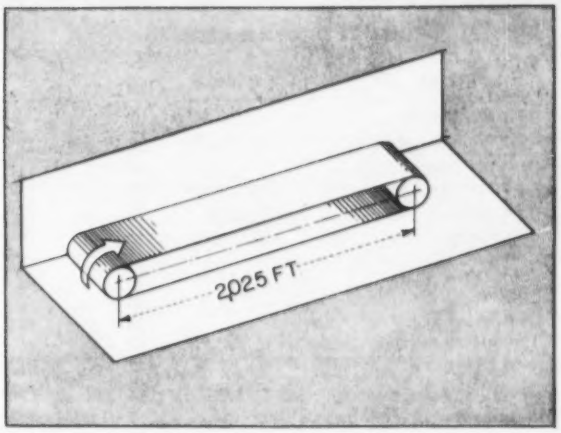
Send him in the one from the Geotimes—you know, vast projects.

Above note from Severn P. Brown
From Geotimes of April 1957
"Don't start vast projects with half vast ideas."

Sincerely,
M. V. Lowry

ROBERT E. SPOERL

Chief engineer, Conveyor and Elevator Belt Sales, Mechanical Goods Div., United States Rubber Co. Mr. Spoerl is the author of both parts of this article.



STARTING POINT in calculating horsepower for any belt conveyor is determination of horsepower needed to drive belt and load between two horizontal points.

How to Select Your Conveyor Belt—Part 1

IF THERE IS ANY SECRET to selecting the right conveyor belt for any job at your mine, mill or smelter, you'll find it in this article and its sequel to be published next month.

First we'll consider the fundamental factors of belt selection—what they are, how they are determined. All the tables you'll need and how to use them will be found on the following pages.

Next month we'll go into the three basic elements of the belt—the carcass, cover and grade and to how to select them. We will also offer some experience-based pointers on how to get greater efficiency and longer life from your conveyor belt.

Belt Selection Factors

Three fundamental factors that govern belt selection are:

1. Capacity—the tons-per-hour your belt must move, basically a function of the belt width, the belt speed and the nature of the material conveyed.

2. Drive horsepower—the total horsepower needed to move the belt and its load.

3. Belt tension—the pull of the drive, the weight of the belt and its load, and the tension induced by the take-up.

Information Needed

Following is a list of information you will need before beginning belt selection calculations. If you are selecting a replacement belt and have kept accurate belt service records, (keeping belt records will be in Part II) you will have all this information at your fingertips.

1. Load characteristics—the weight of the material in pounds per cubic foot (pcf); maximum size of lumps; percentage of lumps to fines, and the physical condition, such as wetness, temperature, oiliness, abrasiveness.

2. Maximum rate of feed—peak loading required of belt in short tons per hour (tph).

3. Center-to-center distance (c-c)—the belt path between centers of head and tail pulleys, measured in feet.

4. Lift or drop of belt (for ascending or descending conveyors only)—difference in elevation of centers of head and tail pulleys, measured in feet; and angle of inclination, measured in degrees.

5. Drive arrangement—type and location of drive, including arc of contact between drive pulley and belt; and whether pulley is bare or lagged.

6. Take-up arrangement—location of take-up and whether it is automatic or manual screw-type.

7. Loading and discharge arrangement—the method and rate of loading and the method of discharging the belt, including the number of loading points and the type of tripper, if any.

How to Choose Correct Belt Size and Speed

Belt capacity is determined by three interrelated factors; the nature of the load, including its weight and other physical characteristics; the belt width; and the speed at which the belt travels.

From an economic standpoint, your belt conveyor should operate fully loaded at maximum permissible belt speed. In addition to lowering haulage efficiency, operating the belt below capacity means greater wear for a given tonnage conveyed.

Table 1 lists average weights of metallic ores and concentrates. For greatest precision in belt selection calculations, however, the exact weight of the material to be conveyed should be obtained by means of samplings.

The relation of capacity to belt width, belt speed and weight of material conveyed is detailed in Table 2. The capacities given are based on average favorable operating conditions, and are considered *rated capacities*.

If your operating conditions approach the ideal, the rated capacity can be exceeded. If operating conditions are unfavorable your belt will not be able to handle the rated capacity. Your belt know-how will be your guide in determining whether you can go over the rated capacity or whether you must stay under it.

Capacity values in Table 2 are based on a belt running at 100 fpm. For example, traveling at 100 fpm, a 72-in. wide belt can carry 1,370 tons of crushed iron ore (weighing 125 pcf) per hour. The values are proportional to belt speed. At 200 fpm, the carrying capacity would be double the table value, or 2,740 tph, and at 300 fpm, three times the table value, or 4,110 tph. Recommended maximum

Table 1: Average Weights Of Ores and Concentrates

Material	Pounds
Bauxite, crushed	75 to 85
Copper ore, crushed	125 to 150
Iron ore (depends on iron percentage)	100 to 200
Iron pyrites, solid	250
2- to 3-in. lumps	135 to 145
1½- to 2-in.	130 to 135
2-in. screenings	120 to 135
Dust	105 to 120
Iron sulphate, pickling tank, wet	80
Iron sulphate, dry	75
Lead ore, galena, solid	465
Litharge, fumed	60
Litharge, skins	260
Sinter	125
Zinc ores, crushed	150 to 160
Zinc oxide	10 to 30

Table 2: Carrying Capacity of Troughed Conveyor Belts*

Tons (2,000 lb) of material per hour at 100 fpm

Belt width (in.)	Weight of material (pcf)					Max. size of material (in.)	
	50	75	100	125	150	Mixed with fines	Uniform in size
12	12	18	24	30	36	2	2
14	17	25	34	42	51	3	2
16	22	33	44	55	66	5	3
18	28	42	56	70	84	6	4
20	34	51	58	85	102	6	4
24	50	75	100	125	150	8	5
30	79	118	158	198	237	12	6
36	114	171	228	285	342	15	8
42	162	243	324	405	486	18	10
48	215	322	430	538	645	22	12
54	270	405	540	675	810	25	13
60	345	517	690	862	1,035	28	15
72	547	820	1,090	1,370	1,640	35	18

*Values listed are obtained with standard three-roller 20-deg troughing idlers. For unequal-length-roller 45-deg idlers, multiply by 1.35 for belts up through 30 in. wide, and by 1.20 for belts over 30 in. wide. For equal-length-roller 45-deg troughing idlers, multiply by 1.50 for belts up through 42 in. wide, and by 1.65 for belts over 42 in. wide.

Values listed are proportional to speed. Example: for 350-fpm belt speed, multiply by 3.5.

speeds for belts of various widths handling different materials are listed in Table 3.

As shown in Table 3, under average operating conditions a 60-in. wide belt can efficiently handle moderately abrasive ore at speeds up to 600 fpm. In the same way that exceptionally favorable operating conditions will allow you to exceed the rated belt capacity given in Table 2, favorable operating conditions may also allow your belt to exceed the speeds given in Table 3. Refinements such as excellent loading and discharge devices and close idler spacing can allow the recommended speed to be increased by as much as 20 to 25%. On the other hand, unfavorable loading and discharge conditions mean that the maximum speed cannot be met. Let your belt-sense be your guide.

In your belt selection calculations, remember that peak capacity values at the maximum rate of feed must be handled. The average load conveyed by the belt might be 500 tph, but if peak build-ups reach 750 tph, use the latter figure.

Another consideration of belt width selection is the structure of the material to be conveyed; that is, the size of lumps and percentage of lumps to fines. This can be arrived at by following the values listed in the last two columns of Table 2. For example, a 60-in. belt would be required to transport 15-in. lump material uniform in size.

The use of skirtboards, close idler spacing, and other design features sometimes allows transport of lumps larger than those specified in Table 2.

How to Determine Total Belt Horsepower

For any given conveyor, total belt horsepower calculations must consider one, two or all of these three horsepower components:

1. Level horsepower—horsepower required to move the belt and load between two horizontal points. All belt conveyors, whether horizontal, ascending or descending, require the level horsepower component.

2. Vertical horsepower—horsepower required to raise or lower the belt and its load. Only calculations for inclined belts consider the vertical horsepower component.

3. Tripper horsepower—horsepower required to operate the mechanical unloading devices known as trippers. Of course, only those conveyors using trippers are concerned with the tripper horsepower component.

Motor horsepower, described fully later, is the actual rating of the motor required to operate a belt conveyor and must include the total belt horsepower plus an additional percentage to compensate for power lost through speed reduction units.

The procedures which follow first consider only the total belt horsepower calculations applicable to horizontal and ascending conveyors. Descending conveyor horsepower requirements are covered on page 78. Separate treatment of these types of conveyors is necessary since ascending or horizontal belts invariably *consume* power in moving the belt and its load, while descending conveyors can be used to *generate* power in lowering the belt and its load. When power is consumed, the horsepower requirements assume a "plus" value, whereas when power is generated, the horsepower requirements sometimes are a "minus" value. We must, therefore, use different methods of calculating horsepower requirements.

Level or Horizontal Power

Starting point in calculating horsepower required for your belt conveyor is to determine the power needed to move the belt and load horizontally. Horizontal or level horsepower is computed by means of the following simple formula:

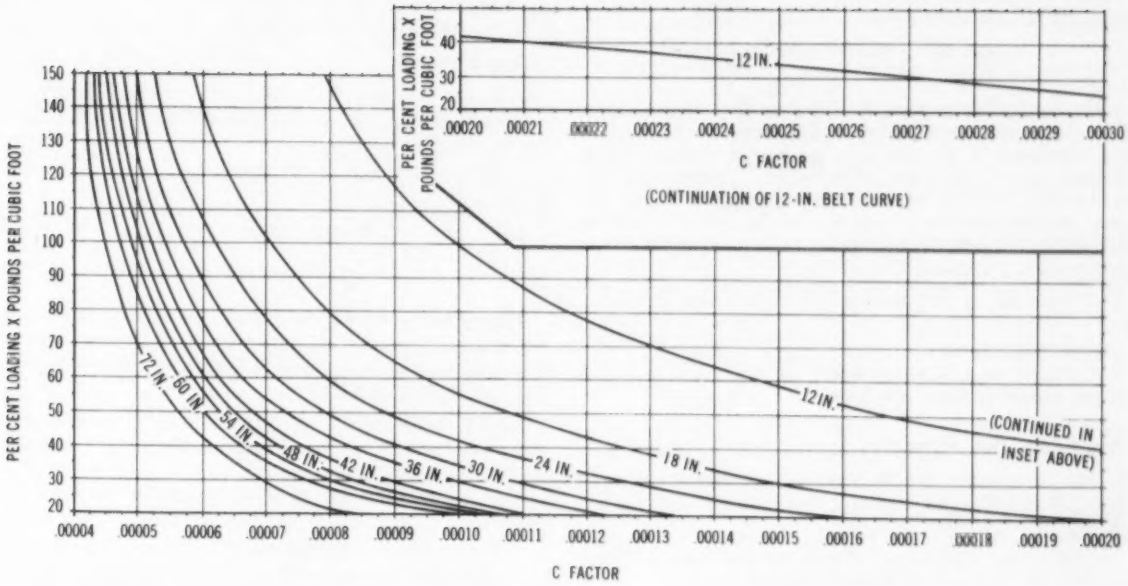
$$\text{Level hp} = \text{C Factor} \times L_e \times \text{tph}$$

Table 3: Recommended Maximum Belt Speeds

Belt width (in.)	Moderately free-flowing material: sized ores, concentrates and pellets (fpm)	Lumps and moderately heavy or abrasive ores (fpm)	Heavy, sharp, very abrasive ores (fpm)
12	300	...	...
18	350	300	...
24	450	400	350
30	500	450	400
36	550	500	450
42	600	500	500
48	600	550	500
54	650	600	550
60	650	600	550
72	600	550	500

Chart 1. C Factors

(20 deg troughing idlers)



C Factor is an experience-developed variable that includes the weight of all moving parts per foot of conveyor length (see Chart 1).

L_a is the adjusted c-c distance (see Table 4) which compensates for the fact that power requirements are not directly proportional to actual c-c lengths.

Tph is the required capacity.

Vertical Horsepower

For ascending conveyors, it is necessary to compute both the level horsepower component and the vertical horsepower component (power required to raise the belt and load).

The vertical horsepower requirement for ascending conveyors can be arirved at by applying the following formula:

$$\text{Vert. hp} = \frac{\text{tph} \times H}{990}$$

Tph is the required capacity of the belt.

H is the height of lift in feet.

990 is the required conversion factor (1 hp = 990 ton-feet per hour).

Tripper Horsepower

Final factor to be considered in computing total belt horsepower requirements is the power required to operate the tripper. If this mechanical unloading device is used, power is consumed in lifting the belt to the top of the tripper for discharging the load. The amount of lift is a prime factor in determining how much power will be consumed. If the lift for your tripper has not been recorded and it would be impractical to make this measurement, use the *average* lift given in Table 5. Note however, that the use of the actual tripper lift is preferable and will result in more precise calculations.

Table 4: Adjusted Lengths

L	L_a	L	L_a	L	L_a	L	L_a	L	L_a	L	L_a
25	160	525	570	1,025	980	1,525	1,390	2,025	1,800	2,525	2,210
50	181	550	591	1,050	1,001	1,550	1,411	2,050	1,821	2,550	2,231
75	201	575	611	1,075	1,021	1,575	1,431	2,075	1,841	2,575	2,251
100	222	600	632	1,100	1,042	1,600	1,452	2,100	1,862	2,600	2,272
125	242	625	652	1,125	1,062	1,625	1,472	2,125	1,882	2,625	2,292
150	263	650	673	1,150	1,083	1,650	1,493	2,150	1,903	2,650	2,313
175	283	675	693	1,175	1,103	1,675	1,513	2,175	1,923	2,675	2,333
200	304	700	714	1,200	1,124	1,700	1,534	2,200	1,944	2,700	2,354
225	324	725	734	1,225	1,144	1,725	1,554	2,225	1,964	2,725	2,374
250	345	750	755	1,250	1,165	1,750	1,575	2,250	1,985	2,750	2,395
275	365	775	775	1,275	1,185	1,775	1,595	2,275	2,005	2,775	2,415
300	386	800	796	1,300	1,206	1,800	1,616	2,300	2,026	2,800	2,436
325	406	825	816	1,325	1,226	1,825	1,626	2,325	2,046	2,825	2,456
350	427	850	837	1,350	1,247	1,850	1,647	2,350	2,067	2,850	2,477
375	447	875	857	1,375	1,267	1,875	1,667	2,375	2,087	2,875	2,497
400	468	900	878	1,400	1,288	1,900	1,698	2,400	2,108	2,900	2,518
425	488	925	898	1,425	1,308	1,925	1,718	2,425	2,128	2,925	2,538
450	509	950	919	1,450	1,329	1,950	1,739	1,450	2,149	2,950	2,559
475	529	975	939	1,475	1,349	1,975	1,759	2,475	2,169	2,975	2,579
500	550	1,000	960	1,500	1,370	2,000	1,780	2,500	2,190	3,000	2,600

Table 5: Average Tripper Lifts

Belt width (in.)	Average tripper height (ft)
12	3.0
18	3.5
24	4.0
30	4.5
36	5.0
42	5.5
48	6.0
54	7.0
60	8.5
72	11.5

Trippers fall into two distinct categories, and experience in the field has led to the development of two separate formulas for calculating the horsepower each type requires. Power requirements for the more fundamental-type stationary trippers and hand-, motor- or rope-propelled trippers can be computed by the following formula:

$$\text{Tripper hp} = \frac{\text{tph x tripper lift in feet}}{990}$$

The more complex type, the belt-propelled tripper (sometimes referred to as a self-propelled tripper), is driven by the movement of the belt over the tripper pulleys, which, in turn, operate the tripper drive wheels. Therefore, power is absorbed from the belt to propel this type of tripper and must be provided for in addition to the power needed to lift the loaded belt. The following formula is applicable to belt-propelled trippers:

$$\text{Tripper hp} = \text{A Factor x fpm } \frac{(\text{tph x tripper lift})}{990}$$

Fpm is belt speed.

A Factor is a constant based on frictional resistance in the tripper pulleys (see Table 6).

Applying the Formulas

Let's determine the horsepower requirements for a typical horizontal belt conveyor installation having the following specifications:

Application = Hauling 125-pcf iron ore from secondary crusher to railroad-car loading station

Required capacity = Crusher feeds belt at controlled rate of 550 tph

Belt width = 30 in.

Belt speed = 300 fpm

Belt length c-c = 2,025 ft

Tripper lift = 4.5 ft

Computing the level horsepower is the first step in computing total belt horsepower requirements for the above system.

Step 1. To find the C Factor:

a. Refer to Table 2 and determine the rated capacity of a 30-in. belt handling 125-pcf material. As shown in Table 2, a 30-in. belt can handle 198 tph of 125-pcf material at a belt speed of 100 fpm. Since the belt in question will travel 300 fpm, the rated or table capacity is: 198 (tph at 100 fpm) x 3 = 594 tph.

b. To find per cent-loading of the belt, divide the required capacity (550 tph) by the rated capacity (594 tph):

$$\frac{550}{594} \times 100 = 92.6\%$$

c. Refer to Chart 1. Multiply the weight of material by per cent-loading:

$$125 \text{ pcf} \times 92.6\% = 115.75 \text{ pcf}$$

Table 6: A Factors

Belt width (in.)	Plain bearings	Anti friction bearings
18	0.0037	0.0025
24	0.0045	0.0030
30	0.0070	0.0047
36	0.0085	0.0058
42	0.0105	0.0070
48	0.0123	0.0082
54	0.0150	0.0100
60	0.0180	0.0120

Locate 115.75 on the vertical axis of Chart 1. Extend a horizontal line from 115.75 to the curve for a 30-in. wide belt. Next drop a straight line from this point through the horizontal axis. Read the value at the intersection with the horizontal axis. The C Factor we find, is 0.000052.

d. Substitute 0.000052 in the level horsepower formula.

Step 2. Find L_a

a. Refer to Table 4. Locate 2,025, the c-c length, in column L. Immediately to the right of 2,025 is the L_a value for this distance, 1,800.

b. Substitute 1,800 for L_a in the level horsepower formula:

$$\text{Level hp} = \text{C Factor } (0.000052) \times L_a\ (1{,}800) \times \text{tph } (550) = 52 \text{ hp}$$

Tripper horsepower is the other factor in total belt horsepower calculations for our conveyor. We'll assume that our installation uses a belt-propelled tripper having anti-friction bearings in tripper pulleys.

Step 1. Locate A Factor in Table 6. A 30-in. wide belt using anti-friction bearings has an A Factor of 0.0047.

Step 2. Substitute values in the tripper horsepower formula:

$$\text{Tripper hp} = \text{A Factor } (0.0047) \times \text{fpm } (300) + \frac{\text{tph } (550) \times \text{tripper life } (4.5)}{990} = 4 \text{ hp (approx.)}$$

To find the total horsepower requirement for the horizontal conveyor we are analyzing, we add level horsepower (52) and the tripper horsepower (4).

$$\text{Total belt horsepower} = 52 + 4 = 56 \text{ hp}$$

Applying Vertical Horsepower Formula

Let's assume that the horizontal belt conveyor we have just analyzed is pivoted vertically about its tail pulley so that the head pulley is raised 125 ft. We then have an ascending conveyor lifting its load 125 ft above the level of the tail pulley. Therefore, we must consider vertical horsepower in addition to level horsepower. We do not consider tripper horsepower since trippers are never employed on constant grade runs. If the conveyor includes a horizontal segment at the end of the run to accommodate a tripper, the inclined segment and the horizontal segment must be analyzed separately.

As mentioned before, computations for any conveyor must consider the level horsepower component. And since level horsepower is not affected by the amount of lift or drop of a conveyor, being based primarily on the c-c distance between pulleys, the level horsepower for this conveyor is exactly the same as that for the horizontal conveyor, or 52 hp.

To determine total belt horsepower:

Step 1. Apply the vertical horsepower formula:

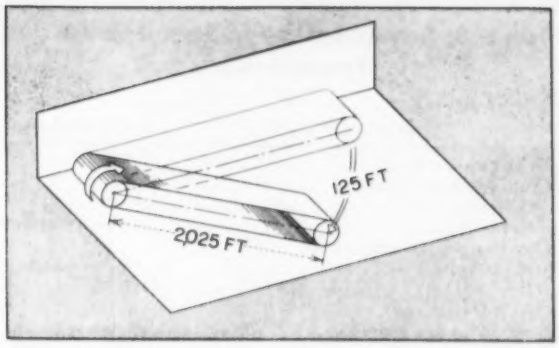
$$\text{Vert. hp} = \frac{\text{tph } (550) \times \text{H } (125)}{990} = 70 \text{ hp (approx.)}$$

Step 2. Add the vertical horsepower and level horsepower.

$$\text{Total belt hp} = 70 + 52 = 122 \text{ hp}$$

Descending Belt Conveyor

The method outlined for calculating horsepower requirements for horizontal or ascending belt conveyors cannot



TOTAL BELT HORSEPOWER for a descending conveyor must consider vertical horsepower needed to keep the loaded belt from running away.

be applied to descending belt conveyors. In horizontal and ascending conveyors, the motor is used only to drive the belt, its load, and if used, the tripper. In descending conveyors, however, the motor can be used for several purposes:

1. For all descending conveyors, the motor must overcome static friction and start the belt and load moving.

2. For gradually descending systems and small slopes, the motor must drive the belt and its load.

3. For steep slopes, the motor must be large enough to keep the loaded belt from overspeeding. As a by-product of this braking or restraining action, the motor may act as a generator—absorbing energy created by gravity pulling on the descending loaded belt. The energy thus developed can be put back into the lines to operate other equipment.

For any conveyor that descends a constant grade, having no horizontal or ascending sections, calculate total belt horsepower by means of the following procedure:

Step 1. Calculate the level horsepower.

Step 2. Determine the vertical horsepower: for descending belts:

$$\text{Vert. hp} = \frac{\text{tph} \times -\text{H}}{990}$$

Tph is the required capacity of the belt.

—H is the difference in elevation between tail and head pulleys. The quantity is "minus" since the effect of gravity on the loaded belt generates power.

Step 3. Compare the level horsepower (Step 1) and the vertical horsepower (Step 2). If the level horsepower is numerically larger than the vertical horsepower, add these values algebraically. The sum will be plus (+). If the vertical horsepower is numerically larger, add the vertical horsepower to ¾ the level horsepower. The sum will be minus (—). (Reducing the level horsepower is necessary to compensate for the safety factors included in the C Factor: when the sum is minus, the safety factors are part of negative values, and more horsepower is required.)

Step 4. Determine the empty belt horsepower as follows:

a. Refer to Table 7. Locate the per cent of level horsepower required to move the empty belt.

b. Substitute values in the formula below.

$$\text{Empty belt hp} = \frac{\text{per cent of level hp at 100\% loading} \times \text{level hp}}{\text{per cent-loading}}$$

Step 5. Compare the empty belt horsepower of Step 4 with the result of Step 3. Use as the total belt horsepower the larger value.

Applying Descending Conveyor Horsepower Formula

Just as we converted the horizontal conveyor into an ascending conveyor by raising the head pulley, let's pivot the conveyor about its tail pulley so that the head is 125 ft below the level of the tail pulley.

We now have a constant-grade descending conveyor with a drop of 125 ft (—H = —125). All other pertinent data is identical to that given for the horizontal conveyor, except for the omission of tripper horsepower. As in the case of our ascending conveyor, a tripper cannot be used with our descending belt. For your convenience, however, the data is repeated below.

Application: Hauling 125-pcf iron ore from secondary crusher to railroad-car loading station
Required capacity: Crusher feeds belt at controlled rate of 550 tph
Belt width: 30 in.
Belt speed: 300 fpm
Belt length
c-c: 2,025 ft
Per cent
loading: 92.6%

Step 1. Calculate level horsepower. (Since, however, level horsepower is not affected by the drop of the belt, the value will be the same as for the horizontal conveyor, or or 52 hp.)

Step 2. Determine vertical horsepower by substituting values in the vertical horsepower formula:

$$\text{Vert. hp} = \frac{\text{tph (550)} \times -\text{H (—125)}}{990} = -70 \text{ hp}$$

Step 3. Compare the level horsepower of Step 1 (+52) with the vertical horsepower of Step 2 (—70). Since the vertical horsepower is *numerically* larger than the level horsepower, we reduce the level horsepower. Adding *algebraically* ¾ the level horsepower to the vertical horsepower, we have:

¾ level hp + (—vert. hp) = (+39) + (—70) = —31 hp

Step 4. Find the empty belt horsepower by first referring to Table 7 and obtaining the percentage of level horsepower required to move the empty belt. Next substitute values in the empty horsepower formula:

$$\text{Empty belt hp} = \frac{\text{Percentage of level hp at 100\% loading (33\%)} \times \text{level hp (52)}}{\text{per cent-loading (92.6\%)}}$$

Step 5. Compare the empty belt horsepower of Step 4 with the result of Step 3. Since the —44 hp is numerically larger than the —31 hp, *use —44 hp as the total belt horsepower.*

Pitching Grade Descending Conveyors

Horsepower requirements for conveyors that descend pitching or undulating grades must be computed differently from those for conveyors that descend constant grades: maximum horsepower may be required when a level or ascending section is loaded and the declined section is empty. In such a case, the different sections of the conveyor must be analyzed individually. Because these calculations may be complicated, you may prefer to contact your belt supplier's field representative for assistance. In addition, it is recommended that reference be made to such manufacturers' literature as U. S. Rubber's *Handbook of Practical Conveyor Belt Engineering.*

Table 7: Power Required to Move Empty Belt

Per cent of level hp at 100% loading

Belt width (in.)	Weight of material (pcf)				
	50	75	100	125	150
24	59	49	42	37	33
30	55	45	38	33	29
36	51	41	35	30	26
42	48	38	31	27	23
48	45	36	29	25	22
54	43	34	27	23	20
60	41	32	26	22	19
72	38	29	24	20	18

Table 8: Power Losses in Speed Reduction Transmissions

Reducer	Per cent lost
Gear reducer unit	5 per unit
Chain and sprocket	
Oil-immersed	5 per reduction
Greased	10 per reduction
Cut-tooth gear and pinion	
Oil-immersed	5 per reduction
Greased	10 per reduction
Cast-tooth gears	10 per reduction
Bevel or miter gears	10 per reduction
V-belts	5 per reduction

Motor Horsepower

In order to arrive at the actual motor horsepower needed to drive a belt conveyor, it is necessary to take into consideration losses in the speed-reduction transmission. Motor horsepower consumed is equal to the total belt horsepower divided by the efficiency of the drive:

$$\text{Consumed motor hp} = \frac{\text{total belt hp}}{\text{drive efficiency}}$$

Power equipment manufacturers specify the efficiency of speed reduction units and this figure should be used in calculating motor horsepower. When this information is not available, drive efficiency can be determined by subtracting the power losses given in Table 8 from 100%.

Applying Motor Horsepower Formula

Let's determine the horsepower rating of the motor required to drive the ascending conveyor for which we calculated the total belt horsepower. Total belt horsepower was, you'll recall, 122. Assuming the conveyor drive is to use a greased chain-and-sprocket unit with one speed reduction:

$$\text{Motor hp} = \frac{\text{total belt hp (122)}}{\text{drive efficiency (1.00—0.10)}} = 136 \text{ hp (approx.)}$$

Since there are no intermediate motor sizes between 125 hp and 150 hp, a 150-hp motor must be used.

Angle of Incline

Permissible angles of incline for conveyor lines depend upon many factors. Irregularly shaped material has less tendency to roll back than smooth, symmetrically shaped material and, as a result, can be conveyed up steeper inclines. Large lumps can be transported up steeper slopes without roll-back when embedded in a considerable amount of fines. Wet materials tend to slide back on inclined conveyors. Therefore, when wet material is handled the angle of incline must be smaller than when dry material is carried However, *slight* moistness or dampness in fine materials permits the use of steeper angles of incline in conveyor design.

Illustrated at right are typical inclined conveyors, with the inclined sections shown as right triangles. Formulas for determining an unknown leg of a conveyor and angles of inclination are given.

Moderate belt speeds, uniform controlled-feed loading, and loading on a horizontal stretch of the belt provided the greatest efficiency on steeply inclined runs. In general, the maximum safe angle of incline is approximately 10 to 15 deg less than the material's angle of repose. (The angle of repose is the angle which a material will assume, when piled on a flat surface, before sliding back on itself.) Table 9 lists maximum angles of inclination for ores and concentrates.

How to Calculate Belt Tensions

Accurate calculation of total belt tensions is essential to determine the type of fabric and number of plies which will provide the carcass that ensures maximum strength and proper troughing at a minimum cost. The total belt tension is actually a combination of three individual tensions.

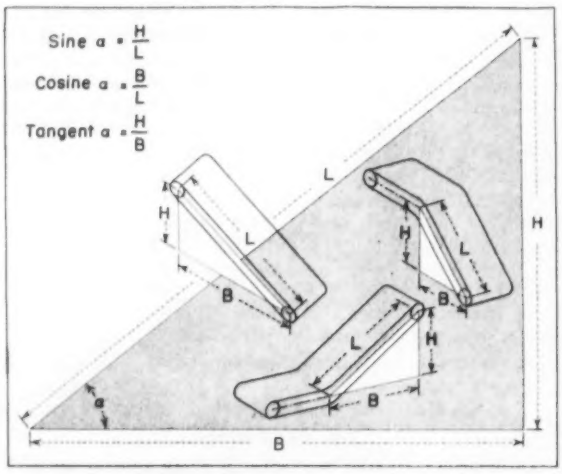
Greatest factor is the *effective tension,* which is equal to the change in the belt tension as the belt passes over the drive pulley. The *slack-side or return-run* tension is a product of the effective tension and the drive factor or K Factor. As shown by Table 10, the K Factor depends on the arc of contact between the belt and drive pulleys, the type of drive, the type of take-up, and whether the pulleys are bare or lagged.

The third tension is the *return slope* tension, the difference between the weight of the belt on the return run and the frictional resistance of the return idlers. The return slope tension is considered for only ascending and descending conveyors.

Belt Tension Formulas

For a horizontal conveyor, calculate total belt tension by means of this formula:

$$\text{Total belt tension} = \frac{\text{total belt hp x } 33{,}000}{\text{fpm}}(1 + K)$$



SIMPLE TRIGONOMETRY is all that's required to determine basic center-to-center distances, angle of incline and the amount of lift or drop.

Table 9: Maximum Permissible Angles of Inclination

Material	Angle in degrees
Bauxite, ground dried	20
Bauxite, run of mine	15
Ore, crushed fine	22
Ore, mixed, lumps and fines	20
Ore, sized	18

Table 10: Drive Factors (K)

Arc of contact (deg)	Type of drive	Screw take-up		Vert. grav. or horz. counterwt. take-up	
		bare pulley	lagged pulley	Bare pulley	Lagged pulley
180	Plain	1.30	0.90	0.85	0.50
190		1.20	0.80	0.78	0.45
200		1.10	0.75	0.72	0.42
210	Snubbed	1.00	0.70	0.67	0.38
220		0.90	0.65	0.62	0.35
230		..	..	0.58	0.32
240		..	..	0.54	0.30
360		..	..	0.26	0.12
380	Tandem	..	..	0.23	0.11
400	or	..	..	0.21	0.09
420	dual	..	..	0.19	0.08
440	motor	..	..	0.17	0.07
450		..	..	0.16	0.07
460		..	..	0.15	0.06
480		..	..	0.14	0.06

Applying Formula

Let's calculate the total belt tension of the horizontal conveyor for which we determined the total belt horsepower. In addition to the formula data that we already have, (total belt horsepower 56, belt speed 300 fpm), we need the data from which we will obtain our K Factor. Therefore assume—

Arc of contact: 210 deg
Drive: snubbed
Pulleys: lagged
Take-up: automatic

Referring to Table 10, we find that our K Factor is 0.38. Insert values in the formula:

$$\text{Total belt tension} = \frac{56 \times 33{,}000}{300}\ (1 + 0.38) = 8{,}500 \text{ lb}$$

(approx.)

Ascending and Descending Conveyors

When selecting a belt for an ascending or descending conveyor, we must consider two composite tensions: First, the basic total belt tension employed above for horizontal conveyors. Second, the inclined belt check tension, which includes calculation of the return slope tension. The larger of these tensions is the one on which final belt selection must be based.

As stated earlier, one of the factors in return slope tension is the weight of the belt. And the weights of different beltings vary in accordance with the type of fabric used, the number of plies, and the thickness and grade of covers. Therefore, to determine return slope tension, we must first tentatively select a belt by means of the basic total belt tension formula: $\frac{\text{Total belt hp} \times 33{,}000}{\text{fpm}}\ (1 + \text{K})$, and then return to apply the inclined belt check tension formula given below basing our calculations on the belt tentatively selected. Belt weights can be found in the manufacturers' catalogs.

If the inclined belt check tension is smaller than the basic total belt tension, the belt already selected is correct. If, however, the inclined belt check tension is larger, it must be used as the basis for a new selection.

Inclined Belt Check Tension Formula

For ascending belts:

$$\text{Inclined belt check tension} = \frac{\text{hp} \times 33{,}000}{\text{fpm}} + (\text{WH} - F_s)$$

For descending belts:

$$\text{Inclined belt check tension} = \frac{\text{hp} \times 33{,}000}{\text{fpm}} + (\text{WH} + F_s)$$

W is the weight of the belt per linear foot in pounds
H is the lift or drop in fee
F_s is the frictional resistance or $\frac{4{,}950 \times \text{level hp}}{\text{fpm}}$

Applying the Formula

As an example, let's determine the total belt tension for the ascending belt whose total horspower was found to be 122 (page 77).

Total belt hp: 122
Level hp: 52 hp
Belt width: 30 in.
Belt speed: 300 fpm
Belt lift: 125 ft
Drive: snubbed
Arc of contact: 210 deg
Pulleys: lagged
Take-up: automatic

Step 1. Find the basic total belt tension:

$$\text{Basic total belt tension} = \frac{122 \times 33{,}000}{300}\ (1 + 0.38) =$$

18,520 lb (approx.)

Step 2. Using the result of Step 1 as the total belt tension, complete the remaining belt selection procedures. From the catalogs of the various conveyor belt manufacturers we could not select a suitable belt with the required strength and cover. For purposes here say we will select a five-ply, Ustex-Nylon Style CL Matchless, with a 3/16-in. top cover and 1/16-in. bottom cover to meet the service requirements of crushed-ore haulage.

Step 3. Now obtain the inclined belt check tension. All values for the formula are given except for W. W equals the weight of the belt per linear foot per inch of belt width (0.293, for belt selected) times the belt width in inches (30), or approximately 9 lb.

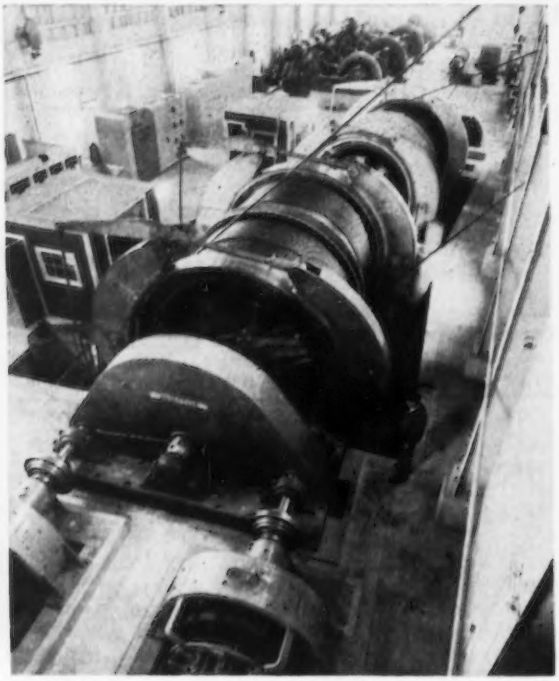
$$\text{Inclined belt check tension} = \frac{\text{total belt hp (122)} \times 33{,}000}{\text{fpm (300)}} + \text{W(9)} \times \text{H(125)} - \frac{4{,}950 \times \text{level hp (52)}}{\text{fpm (300)}} = 13{,}687 \text{ lb}$$

Step 4. Compare the basic total belt tension of Step 1 with the inclined belt check tension of Step 3. Since the basic tension is the larger, our subsequent belt selection procedures were based on the proper tension and the belt we selected is the correct one. If, however, the check tention were larger than the basic tension, we would have to repeat the remaining selection procedures, *using the check tension as the total belt tension.*

Next Month—Part II

Selecting the Carcass, Maximum Permissible Working Tensions, Pulley Diameters, Belt Cover and Grade Selection, Care and Maintenance.

MAIN SHAFT will reach 1,600 ft. Mining on three levels will ultimately produce about 25-million tons of copper ore.



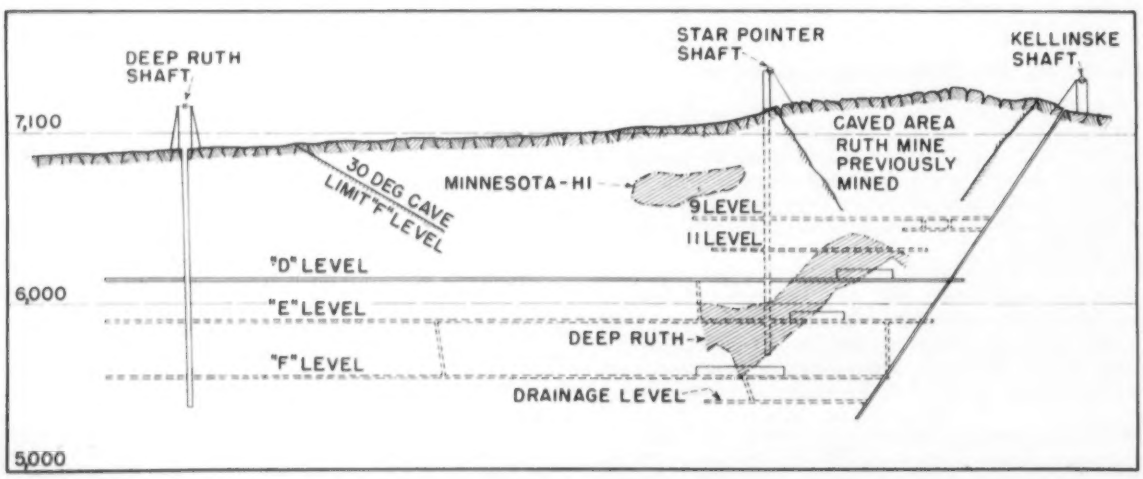
ORE HOIST, in front, raises 12-ton skips at 2,500 fpm by two 1,650-hp motors. Man hoist lifts 50-man double-deck cage.

With shaft sinking water problems whipped, Kennecott is perfecting block caving scheme on Minnesota-Hi offshoot as part of . . . .

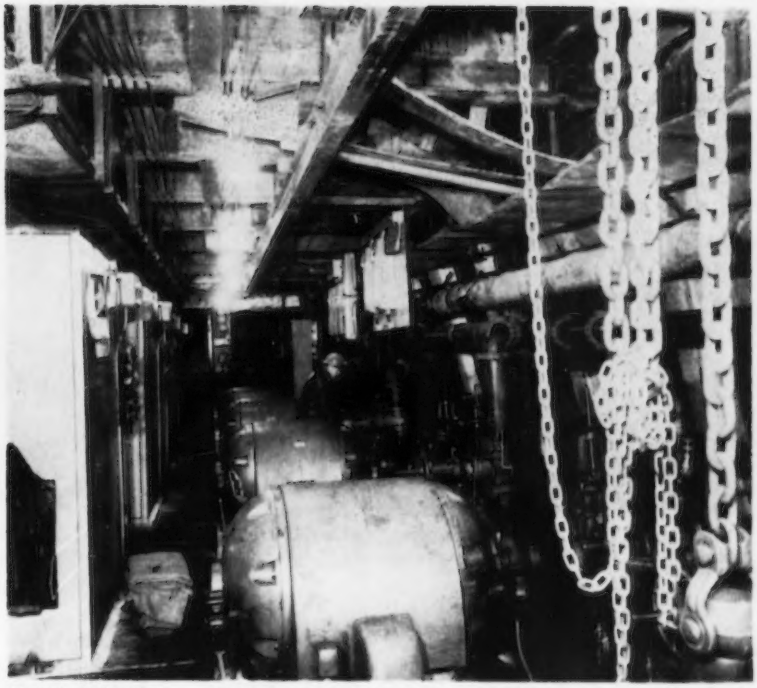
Bringing Deep Ruth Into Production

JOHN B. HUTTL

MINING IN NEVADA'S WHITE PINE COUNTY was given a new lease on life early in 1951 when Kennecott Copper Corp.'s board of directors authorized underground mining of more than 25-million tons of ore averaging 0.81% copper lying adjacent to and beneath the town of Ruth. This act gave birth



MINNESOTA-HI orebody, well within cave limit of Deep Ruth, is being mined first. Shafts are to F Level, D Level is open.



PUMP STATION at 605-ft elevation lifts water to surface in second stage. Built during shaft sinking, it now handles about 2,400 gpm from Deep Ruth orebody.

to what is known today as the Deep Ruth project.

Development preparatory to actual production called for five major projects:

(1) Sinking a new 1,572-ft, 32x8-ft, 5 compartment, vertical production shaft—the Deep Ruth.

(2) Enlarging and deepening the 55-deg incline Kellinske shaft to an eventual depth of 2,245 ft on the incline for use as a ventilation shaft and emergency exit.

(3) Establishing three haulage levels (D, E and F) at 796 ft, 1,048 ft, and 1,375 ft, respectively, below the collar of the Deep Ruth shaft.

(4) Construction of a modern surface plant at the Deep Ruth shaft.

(5) Removal of office buildings and numerous homes from the town of Ruth to the New Ruth townsite.

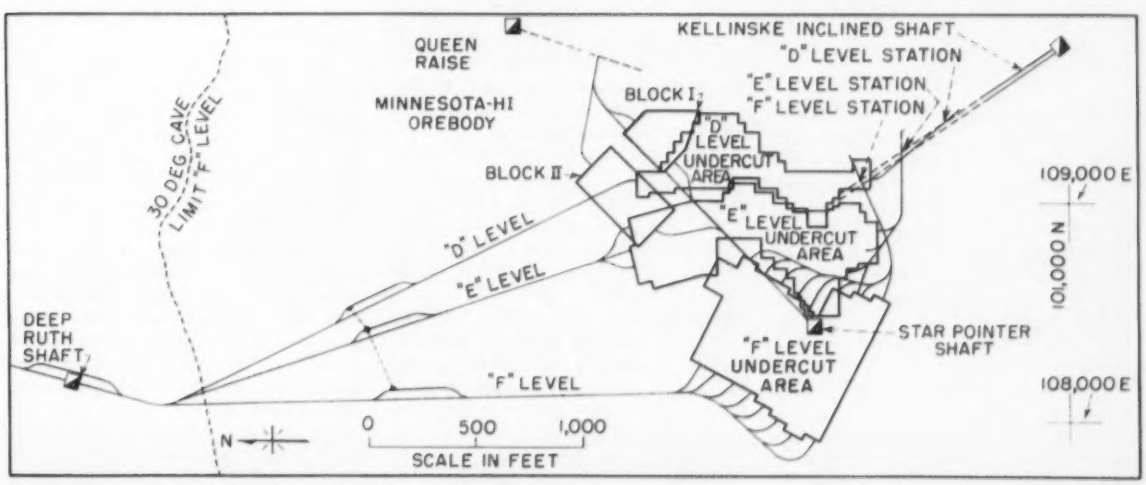
Most of the work was carried out under contract. One contractor sinking the shafts, driving a drift on the D level to join the Deep Ruth and Kellinske shafts, and building the Deep Ruth surface plant; while another removed the buildings and established the town of New Ruth.

Original plans called for production from the Deep Ruth orebody in 1953. However, for two principal reasons this schedule had to be changed. First, heavy water flows encountered early in 1952 held up sinking operations in both shafts necessitating record pumping and large-scale grouting before progress could be resumed. (See *E&MJ* Nov. 1953 p. 95 and J. C. Kinnear Jr.'s article in *Mining Congress Journal*, May 1956.) And secondly, production was further postponed by the decision, reached in 1955, to mine a newly discovered smaller orebody, the Minnesota-Hi, first. To do otherwise would have meant total loss of some 1½-million tons of ore averaging 1.1% copper, as this orebody lies within the cave boundaries of the Deep Ruth orebody and well above the first production (D) level (see *E&MJ* Mar. 1955 p 118). Deep Ruth production is now scheduled for early 1958.

Shaft Sinking

Sinking the shafts for the Deep Ruth mine included a major job of sealing water-bearing formations encountered on the 525-ft horizon in the Deep Ruth shaft and at 875 ft in the Kellinske shaft. Details have been published in references noted above.

But in summary, in the Deep Ruth shaft, the estimated inflow of over 10,000 gpm through unconsolidated ground, was successfully sealed off by placing two concrete plugs, totalling about 44 ft in thickness, under 225 ft of water in the bottom of the shaft. Radial, angle and down holes were then drilled. Through them a grout



LEVELS FAN OUT from Deep Ruth shaft. Minnesota-Hi level connects to Star Pointer. D Level was driven from Kellinske.

mixture made of cement, sand, fly ash, and a patented additive plus water, was pumped under varying pressure to provide a grout curtain around the shaft above and below the plug. A total of 78,000 cu ft of grout was used. Total cost was about $650,000.

At the Kellinske shaft, where inflow was only 1,500 gpm, recovery of shaft was effected by first dewatering with sinking pumps, then confining flow from the single fissure in the shaft bottom to a single collecting pipe by placing a concrete plug around the pipe. And finally grout mixture was pumped through the pipe against the water head to seal off the fissure.

Next came pattern drilling and grouting ahead of the shaft bottom to provide water-free ground through which the shaft could be advanced. Grout pumped amounted to 30,000 cu ft. Cost totalled some $175,000.

In both shafts, it was five months before sinking could begin again.

In the Deep Ruth shaft another nine months' work opened it 75 ft to 650 ft. Advance was held up while a pump station at 605 ft and two deep-well-pump-equipped churn drill holes were established for dewatering the site. Sinking finally recommenced at the end of 1953. Pilot holes were standard practice and no particular trouble was encountered. The 1,360-ft horizon — approximately the bottom production level (F) — was reached in December 1954.

In the Kellinske shaft, sinking continued without much difficulty. But in sinking both shafts below F level it is expected that additional dewatering and grouting will be required. Last stage of sinking was to begin early in 1957.

During much of this time lateral development was done concurrently, from Kellinske shaft primarily. Development and mining of the Minnesota-Hi orebody also has been going ahead from the old Star Pointer shaft.

Deep Ruth Orebody

The Deep Ruth orebody is a downward extension of the porphyry orebody mined up to 1948 through the Star Pointer shaft of the old Ruth mine which produced about 19-million tons of ore. It dips 45 deg and is located between the Deep Ruth and Kellinske shafts. Existence and size of the orebody were proved by extensive drilling and prospect drifting, some dating to 1937. This included churn drilling from the surface and the 900 level of the old Ruth mine. Later considerable diamond drilling was done from a sublevel driven for exploratory purposes from the 1600 level Star Pointer shaft station established previously. In addition lateral work was done in orebody proper for further delineation.

FAIRLY WET conditions were encountered when driving D Level main haulage drift. Men are shown loading explosives. Drift was holed-through in March 1955.

The campaign disclosed additional tonnages, and grades checked closely with those obtained earlier in churn drilling. As economic factors and long-range mining prospects did not warrant development at the time the exploration work was completed, the project remained dormant. It was revived in 1951, with actual sinking operations initiated in that summer.

The Deep Ruth orebody is being developed by the two shafts and the three main levels previously mentioned. The Deep Ruth shaft includes a manway compartment 5½ ft by 4 ft 10 in.; two skip compartments, each 5½ x 6 ft; counterbalance compartment, 5½ ft by 1 ft 2 in.; and cage compartment, 5½ x 9 ft. (Measurements are inside timber.) It is concreted for 65 ft at the collar, below which are timber sets with 10x12-in. dividers, and 12x12-in. wall and end plates. At each shaft station will be a 750-ton loading pocket and a 100-ton waste pocket, the latter served by a special drift so as not to interfere with haulage from and to production centers.

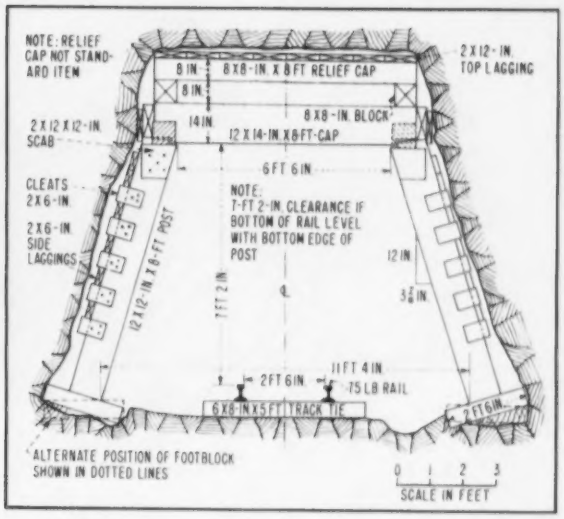
The Deep Ruth shaft end of the mine makes a moderate amount of water, currently about 2,400 gpm. This is pumped up the shaft to a 605 level pump station, and thence to the surface. Pumping equipment available includes three 700-gpm, 500-ft head sinkers at the bottom of the shaft; two 900-gpm, 1,600-ft head submersibles serving as standby units and installed at about 1,300 ft (60 ft above the shaft sump); three 1,000-gpm, 1,000-ft head centrifugals in the temporary E 1048-ft) level pump station; and three 1,-000-gpm, 1,000-ft head centrifugals in the 605 pump station. Water for domestic purposes is provided by a 300-gpm, 1,000-ft head pump installed on the D (796-ft) level in the Kellinske shaft. The other pumps available there are two 1,000-gpm, 1,000-ft head centrifugals.

Distance between the Deep Ruth and Kellinske shafts is about 5,000 ft, and they will be connected by drifts advanced on the main levels. The drift started on the D level some three years ago from the Kellinske shaft was completed late in March 1955. It is 4,400 ft long. All major haulage drifts, as well as general lateral work, are advanced with lightweight pusher drills and steel fitted with tungsten-carbide bits; mucking is done with mechanical loaders. Tracks in main haulage drifts are 75-lb rail laid on 30-in. gage. Tramming of 4-ton gable-bottom cars is with 10-ton trolley locomotives. Plans are maturing for installation of a central traffic control system on the D level.

The roughly 9x9-ft main haulage drifts are heavily timbered as shown in drawing. Squeeze between cap and bridge cap is from 8 to 12 in., depending on the character of the ground supported. Sets similarly constructed but smaller in size are used in secondary and scram drifts. It is planned to use some 12-ft diameter full circle yieldable steel sets in the main haulage drifts in the near future. The Bethlehem 8-ft diameter units, now tested in several scram drifts in the Minnesota-Hi block caving area, have given satisfactory service both as to maintenance and cost.

The surface plant at the Deep Ruth production shaft consists of a 155-ft steel headframe; steel ore and waste bins; a combination hoist and com-

YIELDABLE steel arch for scram drift under Minnesota-Hi orebody proved advantageous and will be used in other areas.


NOTE: RELIEF CAP NOT STANDARD ITEM
8 IN.
8 X 8-IN. X 8 FT RELIEF CAP
2 X 12-IN. TOP LAGGING
8 IN.
8 X 8-IN. BLOCK
14 IN.
2 X 12 X 12-IN. SCAB
12 X 14-IN. X 8-FT CAP
6 FT 6 IN.
CLEATS 2 X 6-IN.
NOTE: 7-FT 2-IN. CLEARANCE IF BOTTOM OF RAIL LEVEL WITH BOTTOM EDGE OF POST
2 X 6-IN. SIDE LAGGINGS
12 IN.
12 X 12-IN. X 8-FT POST
7 FT 2 IN.
3 1/2 IN.
11 FT 4 IN.
2 FT 6 IN.
75 LB RAIL
6 X 8-IN. X 5 FT TRACK TIE
2 FT 6 IN.
ALTERNATE POSITION OF FOOTBLOCK SHOWN IN DOTTED LINES
0 1 2 3
SCALE IN FEET

HEAVY TIMBER sets are used for ground support in main haulage drifts. Extra cap gives plenty of room for squeeze.

pressor building housing a double-drum hoist using 12-ft drums and driven by two 1,650-hp motors capable of handling 12-ton skips at 2,500 fpm, a man hoist to operate a double-deck cage with a load of 50 men at 1,200 fpm, and four air compressors with a total output of 15,000 cfm; office-warehouse; safety department building; change house; saw mill; and electric substations.

Minnesota-Hi Orebody

Minnesota-Hi is an offshoot of the original Ruth orebody. It is being mined by block caving from a drift advanced from the old Star Pointer shaft to the Queen raise (formerly used for ventilation). Actual development work was started late in 1954 and the first ore production was hoisted to the surface late in February 1956. In June, when *E&MJ* visited the mine, daily production exceeded 2,000 tons, and the planned maximum output of 4,000 tpd was to be reached in March 1957. At this rate it is estimated that the ore will be exhausted in less than two years providing ample time to prepare the Deep Ruth for the planned 8,000-tpd production. In addition, the Minnesota-Hi is serving as an excellent proving ground for new ideas and refinements in block caving and ground support for possible use in the Deep Ruth.

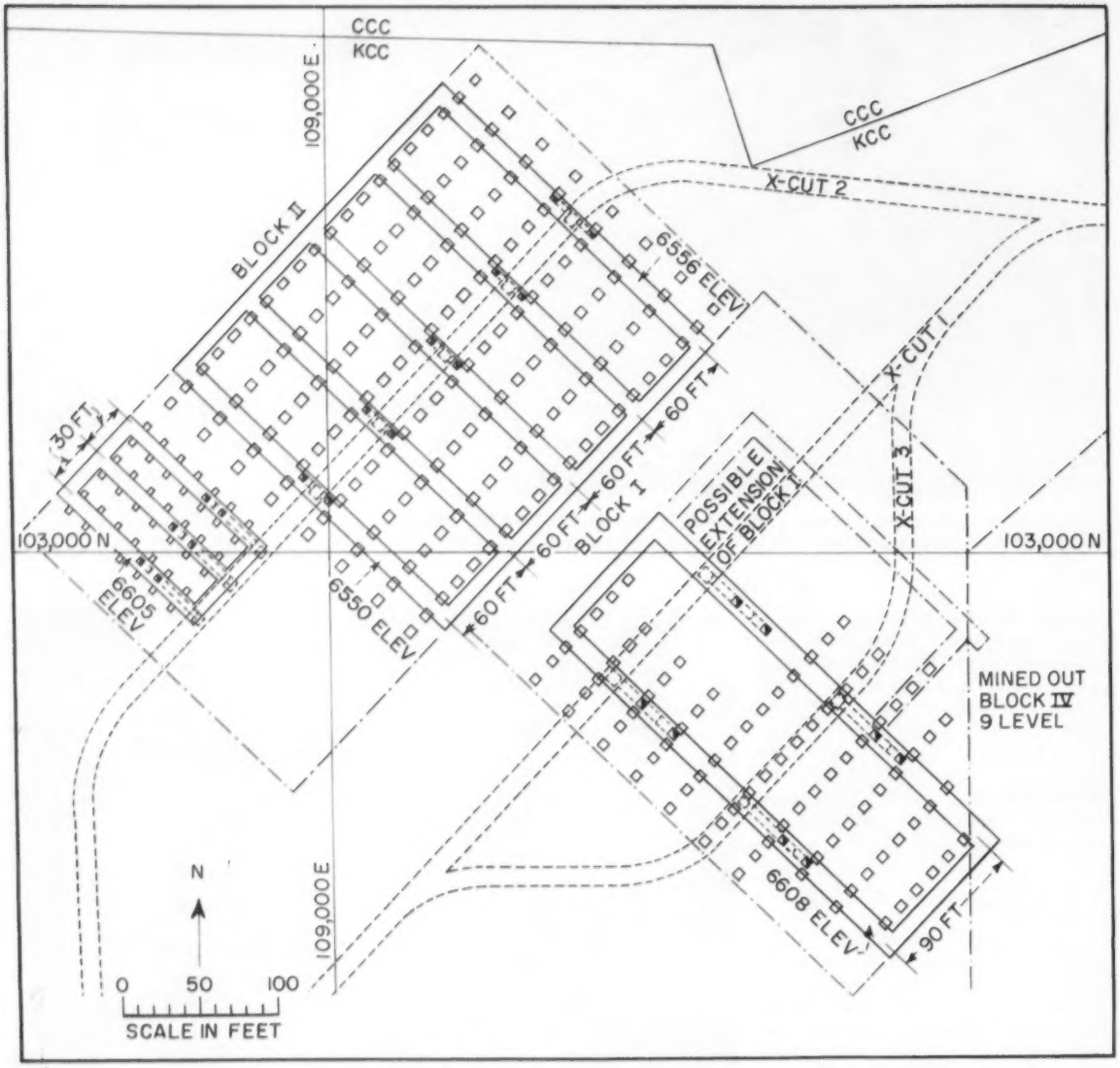
Since start of development, there have been completed about 4,490 ft of main haulage drifts; a new station and ore pocket in the Star Pointer shaft on the 820 horizon; double transfer raise from the 900-ft loading level to the 820 level ore pocket; and an impressive footage of branch, finger and transfer raises and slusher drifts in the block caving area. On the main 820 level, a "rip track" (siding) and maintenance and repair shops for locomotives and cars have been established.

STOPER DRILL is shown being used for undercutting in Minnesota-Hi orebody. Airleg or pusher drills are also used for lateral work. Bits are tungsten carbide.

Drilling in the headings is with pusher drills and steel with tungsten carbide bits. The general round consists of 35 holes drilled in a V-cut pattern to a depth of 6 ft. In raises, the number of holes used per round varies from 10 to 20, depending on the character of the ground. Depth drilled is 4 ft. The round used in fingers consists of 8 holes drilled 5 ft deep. About 120 holes, 6 ft deep, are required to establish an undercut. Both pusher drills and stopers are used in finger, raise and undercut work.

Blasting is with a water resistant 40% gelatin powder in wet ground and with a lower velocity part ammonia base powder in dry ground. Loaded rounds are fired electrically. In blasting undercuts, a parallel-series hookup is used. Little or no secondary blasting is required.

Ore is transported from loading points to loading pocket at Star



SLUSHERS on turntables pull from both sides in Minnesota-Hi. Branch raises feed to scrams except in west end of Block II.

Pointer shaft in trains made up of 4-ton gable-bottom cars hauled by 10-ton trolley locomotives. Hoisting to surface is done in 6-ton skips. Lift is with 400-hp double drum hoist. Man-cage hoist is 150-hp double drum. Hoists are in hoisthouse a short distance from steel headframe.

Block Caving

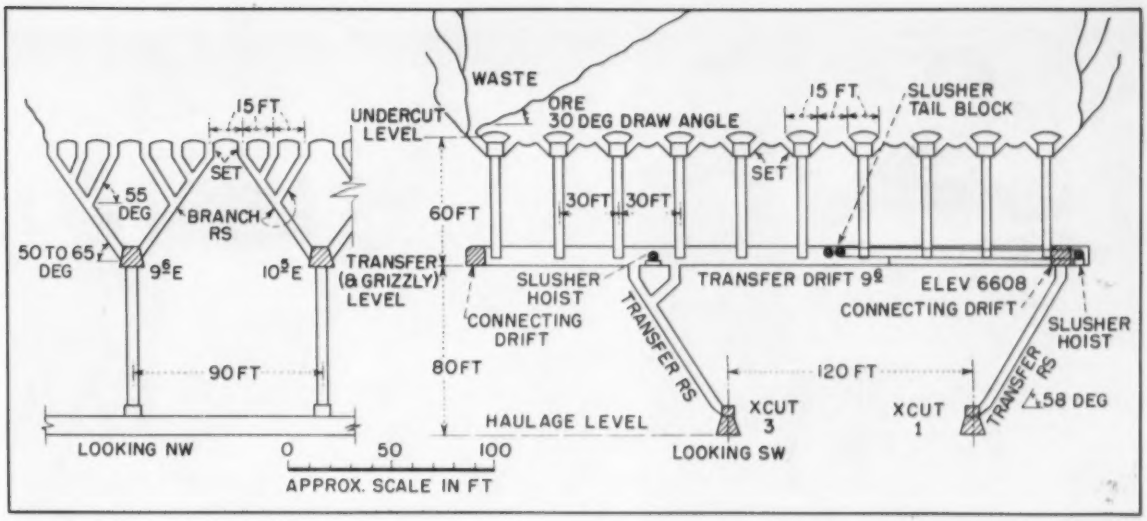
The Minnesota-Hi is being block-caved and, as mentioned before, is a proving ground for schemes to be used on the Deep Ruth orebody. Combinations of gravity and slusher schemes with timber and yieldable steel arch supports are being tried. Accompanying drawings show layout.

First mining was in Block I. Top opening of draw fingers on undercut level are spaced on 15-ft centers. Two fingers incline down to square set on top of inclined branch raise. In plan view, plane of fingers are at right angles to plane of branch raises. Square sets are on 15-ft centers along top edge of branch raise plane. Three square sets feed into one main branch leading down to transfer drift about 60 ft below undercut.

Branch raises enter transfer drift opposite each other at right angles to drift on 30-ft centers. Transfer drifts are on 90-ft centers. Slushers move ore from bottom of branch raises to grizzly topped, inclined transfer raises which drop 80 ft to crosscut on haulage level. Two transfer raises serve each drift, each goes to separate haulage crosscut. Crosscuts are parallel about 120 ft apart, running at right angles to transfer drifts. Openings are timbered.

Next area mined was sub-block at southwest end of Block II. A direct draw slusher scheme was tried to reduce the development footage and the elevation of ore tied-up in a gravity arrangement, as well as to gain the advantages of fast and close-controlled ore flow. Drawholes spaced on 15 x 15-ft centers opened directly onto scrams. Scrams were on 30-ft centers running perpendicular to crosscut on haulage level about 80 ft below. Crosscut runs almost directly under the connecting drift across one end of scrams.

Slusher hoist was mounted on turntable at a point about 40 ft from one end of each 120-ft long scram and scraper dumped onto grizzlies adjacent to hoist—one on each side. Grizzlies top two short branches of ore



SKETCH OF SECTION through Block I shows first scheme used on Minnesota-Hi. All gravity system was originally considered.

pass—one ore pass per scram—which incline down to the haulage crosscut. All raises were timber cribbed.

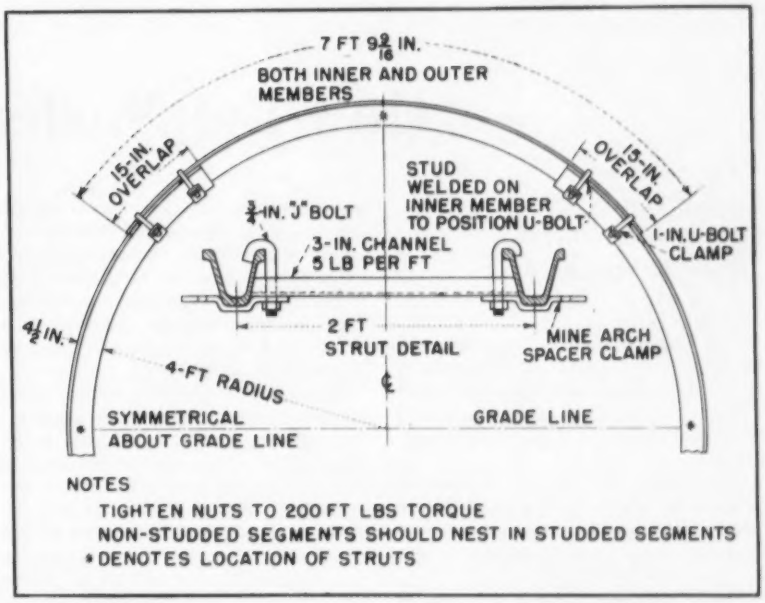
In this sub-block, yieldable steel ring support was tested for scrams. Full circle, 8-ft dia sets were placed on 2-ft centers with 3-ft 8-in. space at draw points. These sets gave adequate support without high maintenance costs or interrupted operation and consequent dilution. Thus the disadvantages of a timbered slusher drift scheme in the "heavy" or "weak" ground were overcome. (See R. C. Nispel's article in *Mining Congress Journal*, July 1956.)

In remainer of Block II, a combination slusher and gravity (branch raise) scheme is used. It is similar to Block I, but branch raise from a single side of slusher drift serves only four draw fingers and slusher drifts are only 40 ft below undercut level and on 60-ft centers.

Slusher hoist is mounted on turntable at midpoint of scram's 240-ft length. At this point, scram crosses haulage crosscut at right angles. Scram bottom is about 15 ft above back of crosscut. Very short, grizzly-topped loading chutes, in scram bottom on each side of slusher hoist, incline down to single loading point directly above cars. Ore is moved by 42-in. scrapers, pulled by 20- and 25-hp hoists.

Draw schedule is planned to maintain a retreat angle of 30 deg for contact between top of caved ore and caved waste. Mining sequence is planned on a retreat from outside boundaries toward center haulage.

It has been found that the initial development cost of a branch raise layout (Block I) is about 40% higher than that of the slusher drift (Block II). Yet, in over-all cost, the figure is higher for the slusher drift operation, chiefly because of high maintenance costs. From test work, these are expected to be reduced materially through use of yieldable full-circular steel sets.

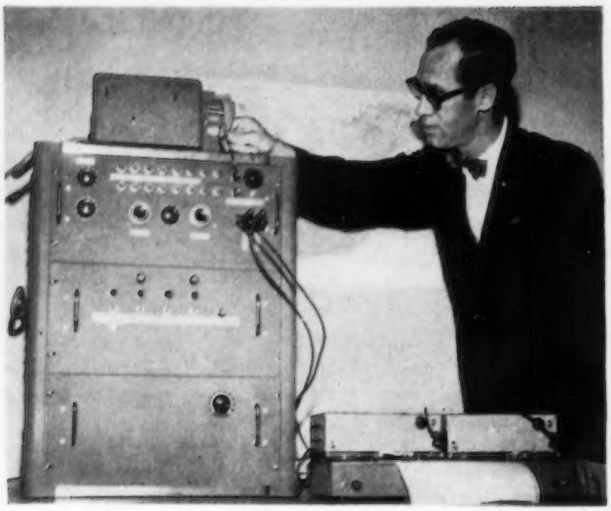


STANDARD rings were used in direct draw scrams at west end of Block II.

Plans for mining the Deep Ruth orebody are essentially the same as currently used in Block II of the Minnesota-Hi except for larger equipment. Blocks will be caved on a retreat from the Kellinske shaft to the Deep Ruth shaft. Length and width of blocks will be determined by rate of production balanced against rate of raise development, but blocks 200 to 350 ft wide and 350 to 600 ft long are being considered in the general plan. In Deep Ruth ore, heights above the draw level vary from 100 to 350 ft and tonnages over a draw point will be as high as 15,000 tons.

Acknowledgment

E&MJ expresses its thanks to J. C. Kinnear Jr., general manager, Nevada Mines Division, Kennecott Copper Corp., McGill, Nev., for permission to publish the aforegoing article. The help given by S. W. Smith, general superintendent of mines, and R. C. Nispel, underground superintendent, in gathering the information presented is acknowledged and appreciated.



The Tools of the Trade . . .

FROM BIRD TO BOTTLE, this equipment makes up the Varian magnetometer. Beneath bird (left) are the slow counter, fast counter and the power supply next to recorder. At right is the analog computer.

How the Nuclear Precession

JAMES I. GIMLETT
KENNETH E. HUNTER
JOHN C. WHITAKER

WITHIN THE LAST TWO YEARS the nuclear precession magnetometer, an airborne unit based on an entirely different principle from previous magnetometers, has been used successfully for exploration and geological mapping.

Developed by Varian Associates, Palo Alto, Calif., and used by Hycon Aerial Surveys, the nuclear precession magnetometer is said to have a number of practical advantages.

Field determinations are based on an immutable property of the proton, hence are independent of any physical environmental change. Thus, neither errors nor instrument drift can be caused by changes in temperature, humidity, pressure or by mechanical shocks. The instrument is calibrated on a constant of nature and not by a Helmholtz system.

All measurements are independent of the detecting device's orientation with respect to the earth's field. Therefore, no misorientation errors are introduced through faulty or "sticky" servos. The detector itself is thus rugged and inexpensive.

Measurements are inherently more accurate since they involve a counting operation as opposed to systems in which amplitudes are measured. As the absolute value of the earth's field is determined, no buckout circuits are needed, eliminating the practical difficulty of keeping a constant current in the buckout coil.

Since readings from a nuclear precession magnetometer are absolute they can be readily correlated with those from other such instruments. When a nuclear ground station is set up within 75 miles of the area being flown, it is no longer necessary to fly a conventional grid system with loops and cross profiles to correct for diurnal variations. This results in faster, more accurate and more economical surveys. The absolute nature of the readings also enables accurate maps to be produced irrespective of how flight lines cross regional or tectonic trends.

The Weight Factor

The magnetometer is extremely light, the complete unit weighing only about 200 lb including bird, winch, cable and test equipment. (A ground 20-lb portable version will be marketed in the near future.) The light weight permits installation in helicopters and light aircraft with a consequent savings in operational costs. Here's how the nuclear precession magnetometer works.

How New Magnetometer Works

This free precession magnetometer uses the principle of nuclear induction, sometimes called nuclear magnetic resonance.

Nuclei possess both intrinsic magnetic and spin moments. These elementary magnets, when placed in a magnetic field, experience a torque which tends to align them with the field. Because of the spin property of the nuclei, they precess about the applied field as they move into alignment. This precession is exactly analogous to that of a free running gyroscope under the action of an external torque. In the case of a nuclear magnetometer the magnetic field is that of the earth and the nuclei in question are protons.

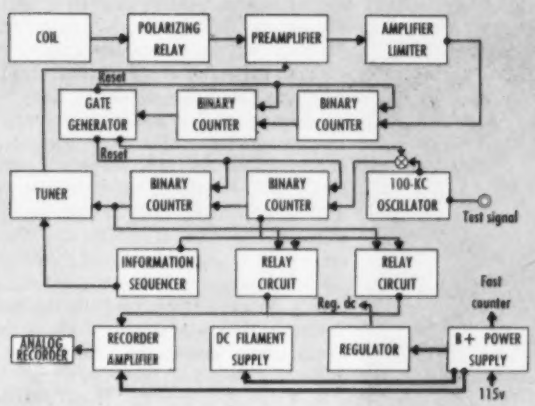
It is easy to show that the frequency of this precession is directly proportional to the strength of the earth's field. In mathematical terms;

$$H=23.4868f$$

where H is the absolute magnitude of the earth's total magnetic field in gammas and f is the precession frequency in cycles per second. The constant of proportionality is the reciprocal (times 2π) of the proton gyromagnetic ratio, a constant which has been measured in the laboratory to an absolute accuracy of 1 part in 40,000. Thus we have essentially a frequency measuring device.

Messrs. Gimlett, Hunter and Whitaker are with the Geophysical Division of Hycon Aerial Surveys, Inc., Pasadena, Calif.

Schematic Diagram of Precession Magnetometer



Initially current through the coil set in a bottle of water polarizes the water. When current is turned off, protons in water tend to align with earth's field. This causes each spinning proton to wobble (precession) which induces a voltage in the coil. Frequency of precession and induced voltage are proportional to earth's field. Signal from coil, now acting as detector, is fed to a narrow band amplifier which transforms it to essentially a square wave. This enters the binary counters of the Slow Counter. The binaries and gate generator set a time interval corresponding to say 512 cycles of precession frequency. During this time interval an ultrastable high frequency oscillator transmits to binaries of the Fast Counter. This total count, proportional to the period of precession signal is a measure of the earth's field. The count is recorded in analog form on a convenient scale for interpretation.

. . . And How They Are Used

IMPORTANT ADVANTAGE shown in this schematic diagram of the precession magnetometer is that measurements involve a counting operation rather than a measuring of amplitudes and absolute values of the earth's field are obtained.

Magnetometer Aids Exploration

Sensing element of the magnetometer is simply a coil in a bottle of water, which serves as the proton source. Each precessing proton moment induces a voltage in the coil. However, because of the complete randomness of the phases and amplitudes of the signals from all the protons in the water sample (6.70×10^{22} protons per cc), there is no net voltage induced in the coil under normal conditions.

To destroy this incoherence a 100 gauss polarizing field is applied to the sample at an angle (between 45 and 90 deg) to the earth's field. Polarization is accomplished by passing a direct current through the coil. When the current is turned off the polarizing field collapses and the protons start to move under the action of the earth's field. They now precess in phase and thus induce a voltage at the precession frequency in the coil, which now serves as a detector. To determine a value of the earth's field it is only necessary to measure this frequency.

Following the detector is a narrow band amplifier which is tuned automatically. The signal is amplified and limited so that it is essentially a square wave when it is fed into the binary counters of the Slow Counter. These binaries and the gate generator establish a time interval corresponding to, say, 512 cycles of the precession frequency. During this time interval the output from an ultrastable high frequency oscillator is fed into the binaries of the Fast Counter. The total count, which is directly proportional to the period of the precession signal, is recorded in analog form at a scale commensurate with the requirements for the record.

Frequency of the precession signal can be measured to a high degree of accuracy. Each measurement is good to ± 1 count. Using a 400-kilocycle oscillator and counting over 512 cycles, this would amount to an accuracy of ± 0.5 gammas in the Los Angeles area. If 1,024 cycles of the precession signal were counted, then each measurement would be good to ± 0.25 gammas.

In the Varian magnetometer each polarizing measuring cycle takes 0.7 seconds. In aircraft flying at 500 ft it is impossible to miss any significant detail in the anomalous field with this fast repetition rate.

How To Use It

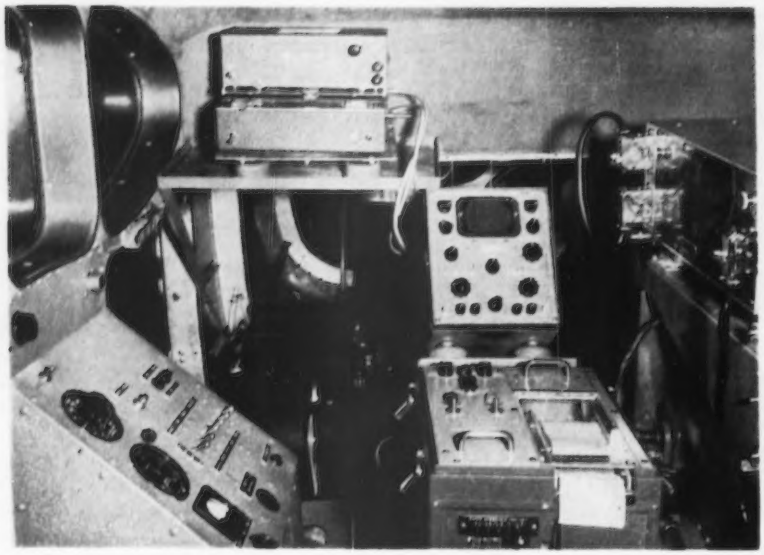
Although aeromagnetics have been used extensively for petroleum reconnaissance exploration programs, airborne magnetometer surveys have not been adequately utilized for mining exploration, except perhaps in Canada.

While magnetite, titaniferous magnetite and some forms of pyrrhotite and hematite can be located directly with the airborne magnetometer, the chief value of aeromagnetics in the solution of mining problems has often been overlooked. Aeromagnetics' chief asset is as an aid to geologic mapping. In its barest terms this means simply that once an aeromagnetic map has been completed, it is readily possible to correlate the map with the known geologic conditions and ore occurrences and thus seek out more geologic information and new ore occurrences based on this correlation.

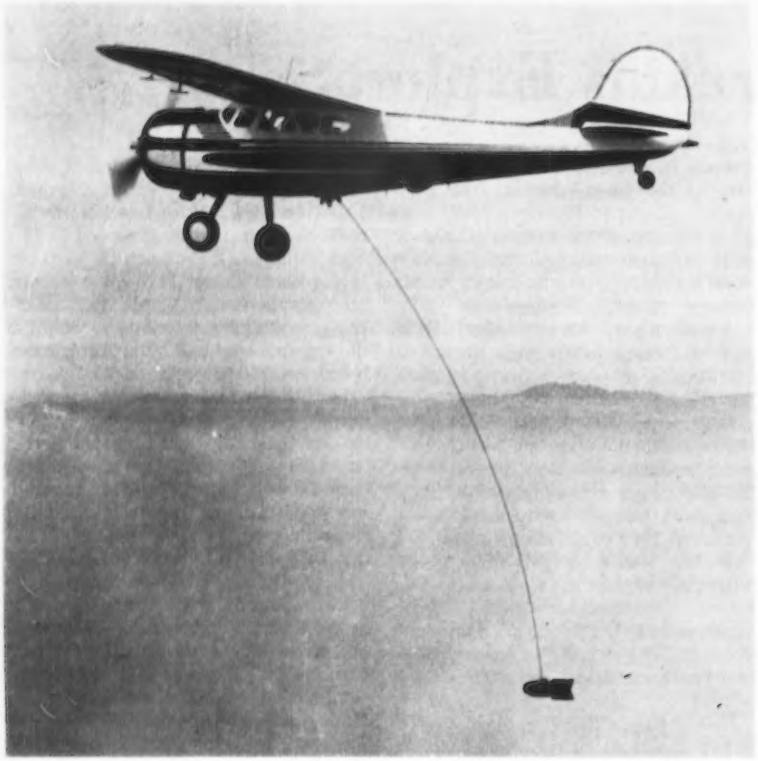
Simplest procedure consists of placing a magnetic contour overlay on the geologic map and correlating the magnetic highs and lows with the known rock types. Where covered areas exist between outcrops similar magnetic intensities and gradients justify the projection of lithologic contacts.

Definition of contact metamorphic deposits such as often occur along the contacts of granites or more basic intrusives with sediments is a case in point. Steep magnetic gradients often define the intrusive boundaries quite closely. Furthermore, the association of magnetic minerals with the ore deposit may be instrumental in locating favorable drill sites along the intrusive contact.

Shear zones, faults, minor fractures and their often important intersections are also mappable. Such features are not necessarily defined as linear magnetic highs. Where linear magnetic lows exist it is quite possible that alteration of magnetite to hematite or limonite has taken place, therefore the



MAGNETOMETER INSTALLATION in aircraft includes left to right in foreground, control panel with radar altimeter head, 35-mm spotting camera, magnetometer recorder, winch for bird. At rear are altimeter recorder, oscilloscope, fast counter.



CESSNA 195 used by Hycon Aerial Surveys carries a 450-hp engine instead of a 330. The aircraft has 24,000-ft service ceiling.

magnetic intensities are less than those over the surrounding rocks.

Serpentinized areas with their possible deposits of nickel, chrome, asbestos are also quite easily defined. Regional as opposed to small scale displacement faulting is easily recognized where basic dikes are offset, thus defining the major zones of faulting.

Extremely valuable correlations gained by nothing more than a comparison of the aeromagnetic contour map with the known geology are often sufficient to obtain a rather thorough regional picture of geologic conditions and pinpoint those areas which bear closer inspection.

At the other extreme are such techniques as statistical evaluation of small anomalies in order to determine whether the anomalies are caused by random errors or by geological conditions. In this latter class fall also the production of first and second derivative magnetic maps and analytical continuation of the magnetic field downward. In non-mathematical terms a first derivative map is one which displays the rate at which the magnetic field is changing. If the magnetic intensity contour lines are close together giving a steep gradient the first derivative has a large value; where the contour lines are spread apart the first derivative is small.

In a similar fashion a second derivative map can be produced from the first derivative or gradient map. Fundamentally, the value of this kind of analysis is that these maps emphasize certain aspects of the information contained in the magnetic results and hence allow an easier evaluation.

Between these two extreme types of evaluation there lies an intermediate interpretation technique depending on relationships derived from the study of simple mathematical models. For magnetic bodies of simple shape such as the sphere, cylinder, thin slabs and the sloping step, relationships involving the dimensions, depths and susceptibility of the bodies can be derived. These can then be applied to the observed magnetic results in such a way that valuable information is gained regarding the possible physical configuration of the materials causing the anomalies.

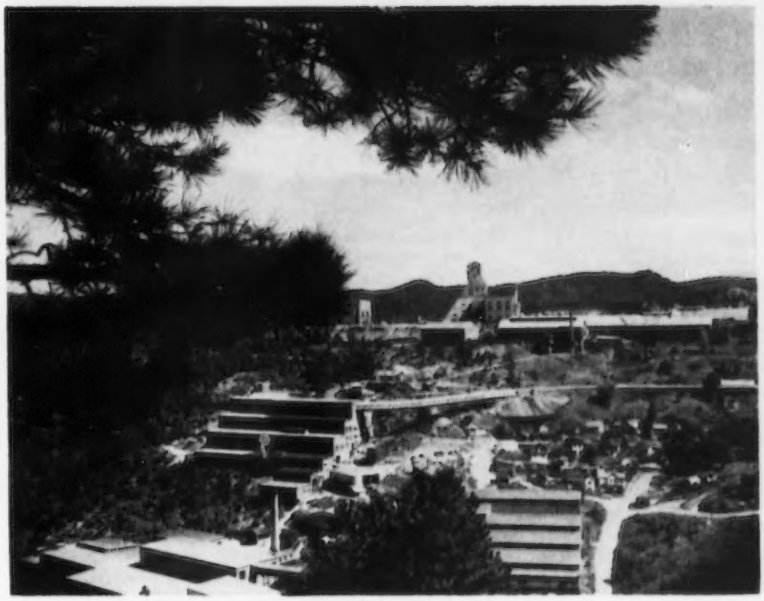
Economical Cessna 195's are used for many magnetometer surveys. Performance of these aircraft has been greatly improved with the addition of 450-hp engines instead of the usual 330-hp installation. These planes have proven themselves as reliable as many multi-engined craft for magnetometer work. The operational ceiling of 24,000 ft makes it possible to fly aerial photography (conventional black and white, infra-red, or color) and magnetometer and/or scintillation surveys with the same aircraft.

Using the light compact instruments in helicopters it is possible to plan flight line spacings as close as 200 ft and terrain clearances of as little as 50 ft. A helicopter can be used to make detailed magnetic surveys of areas which previously were considered to be too small to be economically feasible for an airborne survey.

In addition, helicopters can operate over very rough terrain at relatively low levels, whereas fixed-wing aircraft are forced to go higher for safe clearance.

A question frequently asked by mining men in many parts of the United States is how the country's premier gold mine operator, the Homestake Mining Co., is faring under current adverse conditions and what the management has done to meet rising labor and materials costs in the face of the fixed price received for the metal produced from the Government. To find out, *E&MJ* journeyed early in November 1956, to Lead, S. D., focal point of company operations. Visits with A. H. Shoemaker, general manager, and members of his operating staff, elicited the answers and data on underground and milling operations to be discussed in this article.

The conversations brought out the fact that the only way to carry on under present day conditions was to constantly study, revise and institute practices, both underground and on the surface, with a view to reducing operating costs. Here are some of the improvements made to accomplish this and increase efficiency.



How Homestake Meets Rising Costs

PRINCIPAL IMPROVEMENTS made at the mine include adoption of the airleg-type drill and substitution of the horizontal cut-and-fill method of stoping for shrinkage and square-set stoping. Currently about 58.51% of the 4500-tpd mine output is obtained from horizontal cut-and-fill stopes, 25.77% from pillars left in old shrinkage stoping areas and recovered by timbered cut-and-fill stoping, 14.26% shrinkage from broken ore reserves, and 1.46% from development. About 975 men are employed in the mining department today to produce the daily ore output of 4500 tons, giving a ton per man-shift figure of 4.6. This compares with 4.2 tons in 1952 when ore production per day ranged from 3500 to 3600 tons, and 3.5 tons before World War II with 1175 men producing 4100 tpd.

It is planned to mine new areas opened by horizontal cut-and-fill. In pillar recovery operations, the timbered cut-and-fill stoping method mentioned has replaced the open square-set stoping formerly used under which mining was carried to a height of 75 ft before placement of sand fill. The new method also employs square-set timbering, but only one floor is mined at a time, followed by sand fill. This permits use of 10x10-in. timber in place of the 12x12-in. material required before. Benefits obtained from this are two-fold—a reduction in overall mining costs at the mine, and utilization of smaller logs with consequent savings at the company's lumber department.

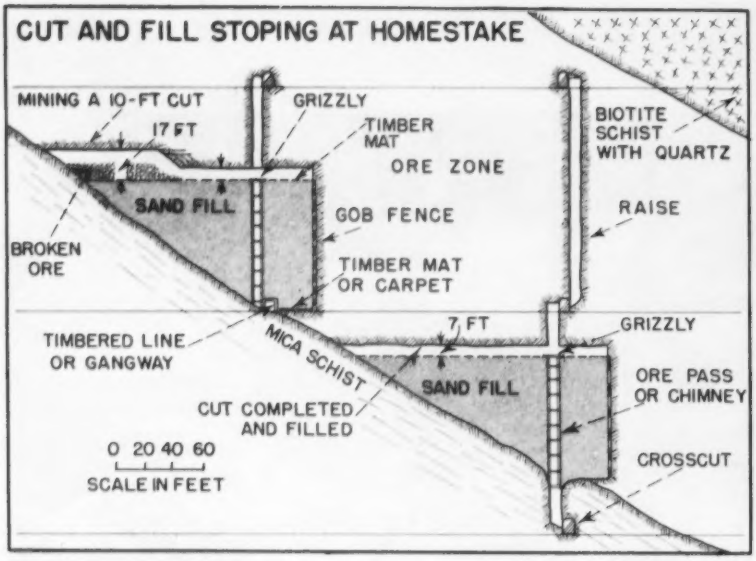
Major improvements made on the surface include remodeling of the crushing plants at the Ross and Yates shafts for three-stage crushing to give a ½-in. mill feed; revision of the mill flowsheet involving elimination of the 180 stamps used; installation of three milling sections for two-stage grinding and one milling section for single-stage grinding; and replacement of the old cone classifiers with Dorr bowl classifiers in the sand-slime separation department of the mill. The change to bowl classifiers has resulted in a cleaner sand product at a higher ratio of sand to slime. This in turn increases the leaching rate, and as a consequence makes possible treatment of a larger tonnage of sand in a given time. The changes made at the mill have resulted in a 37.5% reduction in operating labor, with possibly a somewhat greater economy in maintenance and supply work.

During its 78 years of operation, the Homestake mine has produced more than 85,648,871 tons of ore yielding some 22,717,420 oz gold valued at $795,109,700 at the current Mint price of $35.00 per oz.

Ore reserves blocked out and known are of a magnitude sufficient to assure many years of operation. Much will depend on what the price of gold will be in the future. Mining operations now are carried on at a depth of 5,000 ft, with work in progress to open up new levels below this horizon, bringing with it new hoisting, ventilation and ground support problems. As a consequence, costs will rise steadily in the years ahead regardless of whether or not the present inflationary period ends soon.

Geology

Dr. D. H. McLaughlin, president of Homestake, covers the subject in an excellent manner in *E&MJ*, Vol. 132, pp 324-329. He states that commercial ore is almost entirely confined to one distinctive layer of cummingtonite-bearing schist, locally known as Homestake formation, which can be traced as a well-defined unit for many miles through the highly folded, metamorphosed pre-Cambrian sediments of the northern Black Hills. The ledges or orebodies lie along a group of minor folds that together form a large complex anticline. Each separate orebody follows its own specific fold, and all except the Caledonia ledge dip steeply to the northeast and plunge at from 35



STOPE DEVELOPMENT starts by driving crosscuts 200 ft apart then raising 150 ft to the level above. Drifts, crosscuts and gangways are 7x7; raises are 5x7.

PLACING square-set in timbered cut-and-fill stope in pillar.

to 40 deg to the southeast with the prevailing structure. The orebodies are irregular slabs or pods, with the longest dimension parallel to the plunging structure. Outlines conform more or less to the shape of the replaced bed in the particular structure that is followed. Individual ledges range from 50 to 150 ft thick, and from 300 to 700 ft along the strike in horizontal plan. Where several folds and accompanying orebodies are bunched together, widths of more than 300 ft have been mined, and continuous ore followed for more than 1200 ft on certain upper levels.

The ore consists of cummingtonite-chlorite schist of the Homestake formation, with thin layers of quartz sand and some original iron-magnesium carbonate, which has been mineralized with numerous irregular veins, lenses and sadles of white quartz and with ankerite, chlorite, arsenopyrite, pyrrhotite, pyrite, magnetite and gold.

Mine Development

Here is what the present mine surface plant installations and underground operations look like.

The principal openings serving the mine are the vertical Yates and Ross shafts, with the Yates extending to the 5,000-ft level and the Ross being deepened to that point from the 4100-ft level. Latter work is done by driving a 6x9-ft pilot raise from the 5,000-ft level to the Ross shaft sump, followed by widening the cross-section of the raise to full shaft size and installing steel shaft sets. This last phase of the operation is now in progress.

The shafts handle all mine production, men and materials. The Ross shaft is divided into 6 compartments, with 7½-ton skips used in the two skip compartments measuring 5-ft 7-in. by 5-ft 8-in. inside the steel sets, while the Yates shaft contains 7 compartments, and the two skip compartments in which 8-ton skips operate measure 6-ft 2-in. by 5-ft 9-in. inside the steel sets. Ore and man hoists installed at both shafts are Nordberg double-drum (cylindro-conical) units, with the Ross ore hoist driven by two 1500-hp, 300-rpm, dc motors and the man hoist by one motor of like design and power. Each of the Yates hoists is powered by two 1500-hp, 350-rpm, dc motors. Diameter of all hoisting cables, save for the Ross man hoist which is 1⅝-in., is 1⅞-in. Maximum hoisting speed is 3,078 fpm.

To carry on exploration and development work below the 5,000-ft horizon, a new underground shaft, the No. 4, has recently been sunk some 700 ft below the 5,000-ft level, and drifting to the projected location of known orebodies is now in progress on the 5300- and 5600-ft levels. The shaft is currently served by a cage hoist. Provision has been made for later installation of an ore hoist for handling production from the new levels. Equipment used in sinking the No. 4 shaft included an I-R shaft drill jumbo with drifters and a B-E hydro mucker for loading broken material into 70-cu ft sinking buckets.

Orebodies

The main producing orebodies are the Main ledge and No. 9 ledge. A small amount of ore is obtained from the No. 5 and No. 7 ledges. The Main ledge has been developed from the surface to the 5,000-ft level. Development of No. 9 ledge, extending from the 2,000-ft level to the 5,000-ft level, started in 1939. The bulk of ore production is currently coming from the 12 levels established between the 2450- and 4100-ft horizons. Minor tonnages are mined from 7 levels between the 1400-ft and 2450-ft horizons, and material mined below the 4100-ft level is entirely development ore. Active levels between the 1250- and 5,000-ft horizons total 27. All are at 150-ft vertical intervals. The levels above the 1100-ft horizon, now entirely worked out, were established at 100-ft vertical intervals.

Mining Methods

Recently developed orebodies are all mined by horizontal cut-and-fill stoping. A technique of stair stepping stopes in a massive ore zone plunging at an angle of 35 deg is shown. Stope development starts by driving crosscuts about 200 ft apart, followed by extending a raise to the level 150 ft above. The drifts, crosscuts and gangways are carried 7x7 ft in cross-section and raises 5x7. Stoping starts at the foot of the ore zone, and sequence of operation is as follows: First, a horizontal 10-ft cut is mined by drilling diagonal and horizontal holes as shown and blasting each round onto the floor covered with locally produced 2-in. pine slabs, then slushing the broken ore to the timbered vertical ore pass, extending timbering of ore pass 10 ft plus, placing 10-ft layer of mill sand tailings, and repeat mining cycle. Ore

TRIPLE-DRUM slusher hoist with safety screen operating 48-in. Pacific scraper in horizontal cut-and-fill stope.

DRILLING in stopes and laterals is done with this Cleveland airleg drill using ⅞-in. hex. steel and 1⅝-in. TC bits.

passes are covered with steel grizzlies, spaced 18 in. Stopes vary in size, but some measuring 60 ft wide and 400 ft long have been mined.

Development drifts, crosscuts and minor haulageways in active mining areas are driven 7x7 ft in cross-section and raises 5x7 ft. Main haulageways from the 4850-ft level down are 8x8 ft. Homestake ore is hard, tough and abrasive. As a consequence, a burn cut round is used in drifts, crosscuts and raises. Number of holes drilled per round averages 30, with from 5 to 7 holes drilled in the burn. Holes are drilled to a depth of 9½ ft in drifts and other laterals, and 8 ft in raises. Blasting is done with 45% Gelx No. 2. Millisecond delays are used in the cut holes and regular delay caps in the remaining holes of the round. Loaded rounds are detonated electrically.

Equipment Used Underground

Drills—Cleveland airleg drills with ⅞-in. hexagonal carbon steel and 1⅜-in. tungsten-carbide bits are used in stopes, drifts and crosscuts. A few drift crews still use G-D and Cleveland 3½-in. drifters with 1-in. quarter-octagon steel and 1⅝-in. tungsten-carbide bits. In raises, 120-lb G-D stopers are used in conjunction with 1-in. quarter-octagon steel and 1⅝-in. tungsten-carbide bits. These units are being replaced with 90-lb stopers.

Loaders—Eimco 12B and 21 RockerShovels are used in drifting and tunnel operations.

Scraper hoists and scrapers — Joy triple-drum 20-, 25- and 30-hp slusher hoists are used in horizontal cut-and-fill stopes, with 48-in. Pacific scrapers, and G-D and I-R 15-hp double-drum units with 42-in. Pacific scrapers in timbered cut-and-fill stopes in pillars.

Locomotives—Goodman 8-ton battery locomotives are used in main haulage work. Some of the older compressed-air driven units handle supplies and perform switching operations.

Mine cars—Granby-type 60-cu ft cars are used in main haulageways, and 32-cu ft rocker dump cars for handling waste. Both use Cor-Ten body plates. Tracks are laid with 40-lb rails on 18-in. gage.

Pipes for sand filling—All main lines are rubber lined and consist of 5- and 6-in. pipe. Conventional 4-in. pipe is used for distributing sand tailings into stopes. Delivery of sand is by gravity. The per cent sand-water ratio is 55:45.

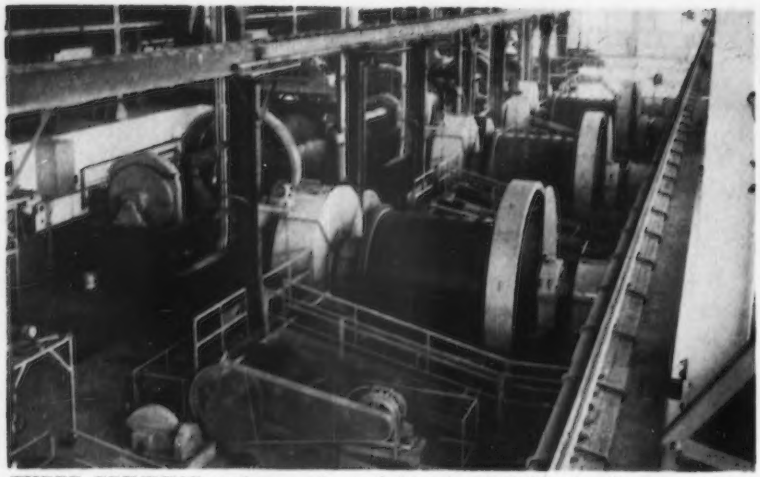
Pumps—The mine makes relatively little water. Most of the water pumped comes from sand filling operations. Volume pumped ranges from 700 to 800 gpm. It is handled by 1500-gpm I-R centrifugal pumps, with two units installed in each of the pumping stations on the 1250-, 2450- and 3650-ft levels in the Ross shaft. A fourth pumping station of like design is scheduled for installation on the 4850-ft level.

Fans—Units installed on the surface include a 250,000-cfm Jeffrey Aerodyne at the Oro Hondo ventilation shaft, and two Sirocco No. 19 exhaust fans, also of 250,000-cfm capacity, at No. 1 and 2 air raises. Underground portable and stationary blower fans are used. A 70-ton cooling plant (water spray system patterned after those that were formerly used in Butte, Mont.) has recently been installed on the 4850-ft level to provide cooled air to workings on the lower horizons where higher rock temperatures prevail (103 deg F on the 5600-ft level).

The company has recently started work on a new ventilation system at a cost of several million dollars preparatory to scheduled deep level mining. shaft, known as No. 5 shaft, about 1 mile from the Oro Hondo ventilation shaft to a depth of 5,000 ft, driving a 4,000-ft exhaust drift on the 3950-ft part will be made up of corrugated, by stripping. Shaft lining for the most pleted by driving a 6x9-ft pilot raise from the 5,000-ft level in long sections (900-ft) and subsequent enlargement to the full 19-ft circular cross-section section of the Oro Hondo shaft. Sinkwith the remaining 5,000 ft to be coming operations have been started at the No. 5 shaft site. This work will be The project involves sinking a new 19-ft outside diameter circular ventilation carried to a depth of about 1,000-ft, level to the Oro Hondo shaft, extending a large cross-section exhaust raise from the 5,000-ft level to the 3950-ft level almost parallel with the new No. 5 shaft, and enlargement of the crossgalvanized iron sheets and steel sets, and concrete where necessary. When the No. 5 shaft is completed, the Jeffrey Aerodyne fan mentioned will be moved to it from the Oro Hondo shaft prior to the start of enlarging operations at the Oro Hondo.

Diamond Drilling

Six crews of two men each are at work throughout the mine. Their chief task is to outline ore zones on new levels and delineate ore boundaries in

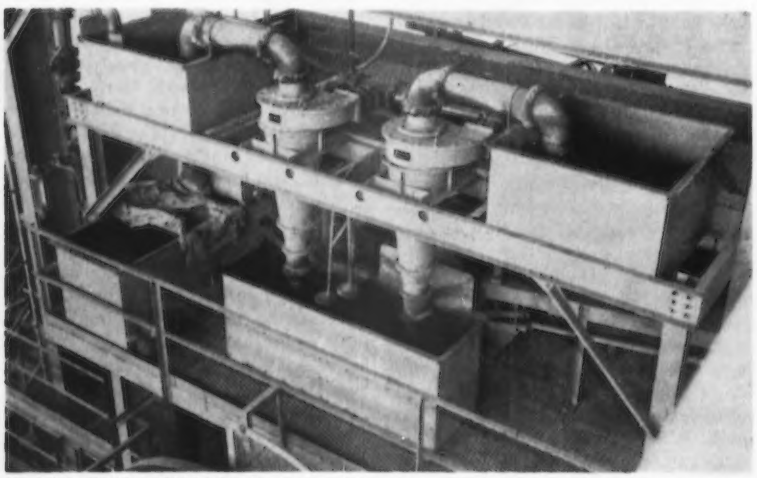


THREE GRINDING sections, each consisting of a 6x12-ft rod mill and a 9x11-ft ball mill with HX rake classifier.

Sizing of Homestake Milling Products

Mesh (inches)	Feed to open circuit rod mill (per cent weight)	Rod mill discharge (per cent weight)	Ball mill discharge (per cent weight)	Ball mill class. o'flow (per cent weight)	Bowl classifier products	
					Sand	Slime
+¾	0.5					
+½	10.5					
+¼	37.0					
+6	16.0					
+8	5.5	13.0				
+10	4.5	9.5	5.0			
+28	8.5	27.5	16.5			
+48	3.0	9.5	19.0	0.0	0.0	
+80	1.5	5.5	19.0	2.5	4.8	
+100	1.5	3.0	10.0	6.5	12.5	
+150	1.5	4.5	9.5	11.0	21.2	
+200	2.0	5.0	6.0	14.5	25.8	2.2
−200	8.0	22.5	15.0	65.5	35.7	97.8
	100.0	100.0	100.0	100.0	100.0	100.0

Milling rate = 4500 tpd (monthly average) 2340 tpd
Ball mill solids = 72%
Ball mill class. o'flow solids = 16 to 17%
Ball mill circulating load 500 to 550 = %
Cyanidation of sand, 52% of tonnage = 2340 tpd
Cyanidation of slime, 40% of tonnage = 2160 tpd
Rod mill solids = 75%



THESE TWO CYCLONES in the single-stage, fourth grinding section, operate in closed circuit with 9x11-ft ball mill.

stoping areas. The drills employed use EX bits.

Crushing

Ore hoisted through the Yates and Ross shafts in 8- and 7½-ton skips is dumped automatically into skip dump bins, each capable of holding 275 tons and equipped with a Ross chain feeder. The crushing plant at each shaft has an A-C gyratory 30-in. Superior primary crusher served by the Ross chain feeder and set to give a minus 4-in. product; a secondary 7-ft standard Symons cone crusher to reduce the gyratory crusher product to minus 2-in.; and a tertiary 7-ft short-head Symons cone crusher operating in closed circuit with two 5x12-ft Tyler, F-600, two-deck vibrating screens. The minus ½-in. screen undersize or rod mill feed is belt conveyed to a 2600-ton storage bin at the Yates shaft and to a 3750-ton bin at the Ross shaft. The crushing operations described now do between one-half and two-thirds of the work formerly done by the 180 stamps.

Transportation of crushed ore from the two storage bins to the 5,000-ton bin at the head of the south mill is done in trains made up of thirty 5-ton bottom-dump cars drawn by a 10-ton G-E trolley locomotive. Loading of trains is rapid and continuous. This is made possible by special steel tips or plates extending from one end of a car over the end of that following, which permits the bin chute to remain open until the last car has been filled. No spillage between cars can occur.

Milling Methods

Equipment changes and grinding practices employed currently at the South mill are the outgrowth of studies and test work covering crushing, grinding and cyanidation carried on after close of World War II in anticipation of inflationary conditions that inevitably follow each war. The streamlined flowsheet finally adopted has resulted in lower over-all milling costs.

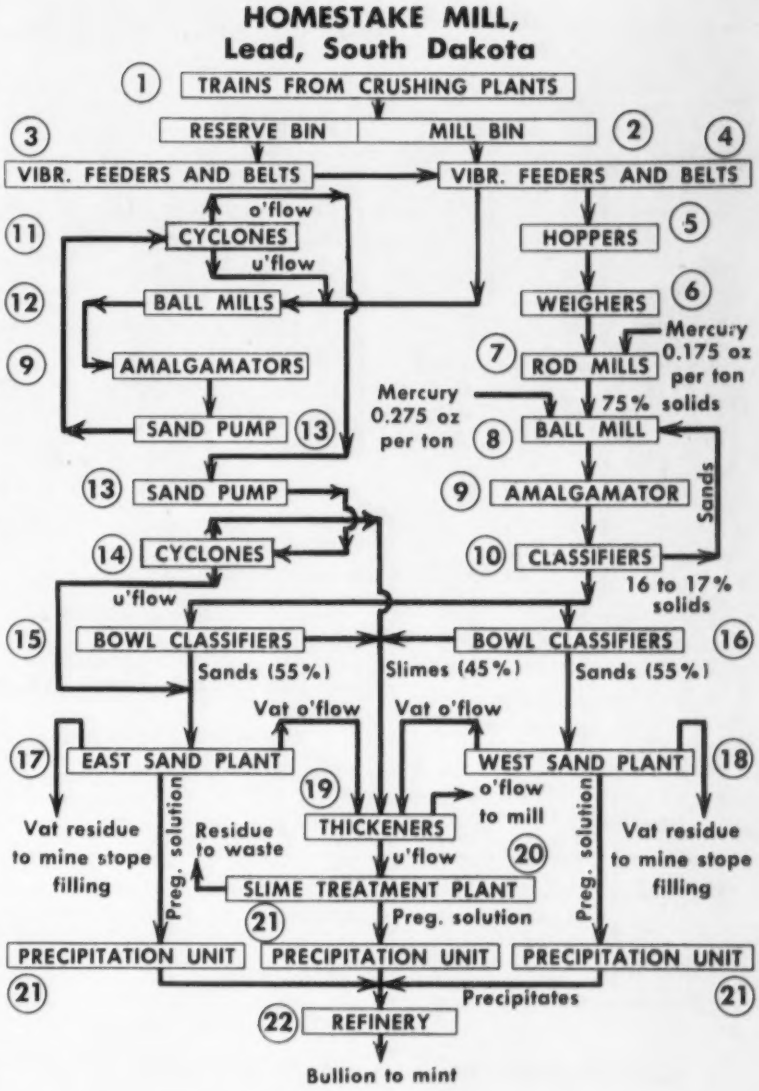
The grinding facilities now in use consist of three sections, each made up of a large rod mill in open circuit and a ball mill in closed circuit with a rake classifier, and a fourth ball mill served by two cyclones. This is in contrast to the 10 rod mills, all in closed circuit with mechanical classifiers, and 4 ball mill-classifier and 4 pebble mill-classifier units for regrinding about 50% of the rod mill products following the 180 stamps under the old plant layout. The mechanical cone classifiers and dewatering cones formerly used in the grinding and sand-slime separation departments have been replaced with rake and bowl classifiers. All design

and construction work was done by Homestake engineering and mechanical department personnel. Equipment layouts were designed to fit into existing buildings, and their installation was scheduled so as to cause minimum interference with mill operations.

As the character of the Homestake ore has remained unchanged, metallurgy today follows closely that practiced before mill reconstruction. The ore contains a neglible amount of concentratable material, so no flotation or tabling is required. Most of the gold is in the free state, the individual particles in general being very small, though there are enough larger flakes to make quick recovery of as much gold as possible by amalgamation very desirable. About 71.5% of the gold is recovered by this method. Presence of ferrous compounds in many of the gangue minerals, which if unchanged would have a deleterious effect on the cyanide subsequently used as a solvent for the gold, was the principal reason for retaining the practice of milling in water. In addition, it also permits gold recovery by amalgamation, thereby reducing the ultimate residue loss. Treatment of sands and slimes remains unchanged, with operating cycles given in the accompanying tables. Percentage of gold recovered from the sand and slime fractions is 17 and 8.5% respectively. Cyanidation recovery is 90%.

Feed Control

The fine-ore storage bin installation at the head of the mill consists of a 3500-ton steel bin serving the three two-stage grinding sections and the single-stage grinding section placed in operation recently, and a reserve ore bin of 1500-ton capacity. Ore from the reserve bin can be withdrawn through 8 chutes, each with a gate and 24x48 in. vibrating feeder, and transported by a 24-in. belt conveyor to the hopper ahead of the Transportoweigher serving any one of the three grinding sections. The larger bin has 12 chutes, 4 for each grinding section, equipped with gates and vibrating feeders duplicating those available on the reserve bin. The feeders discharge onto 24-in. belt conveyors leading to the hoppers ahead of the Transportoweighers. Two of each set of 4 feeders are manually controlled, with the other two regulated automatically by the weigher unit. The Transportoweigher proper is a packaged unit consisting of a 24-in. belt conveyor, weigher, and a choice of controllers, indicators, totalizers, and others. A control panel on the mill floor for heavy equipment and Transportoweigher contains a tonnage rate indicator, 24-hr chart recorder, a tonnage totalizer and two push buttons to raise or lower the rate of setting.



Mill, Sand and Slime Treatment Plants

LEGEND

1. Trains made up of thirty 5-ton from Yates and Ross shaft crushing plants
2. 3500-ton mill bin and 1500-ton reserve ore bin
3. Eight 24x48-in. Jeffrey-Traylor vibrating feeders and 24-in. belt conveyor to mill ore bin
4. Twelve 24x48 in. Jeffrey-Traylor vibrating feeders and three 24-in. belt conveyors discharging into hoppers ahead of Transportoweighers
5. Hoppers
6. Four transportoweighers
7. Three 6x12-ft Marcy rod mills
8. Three A-C 9x11-ft ball mills
9. Four Clark-Todd amalgamators
10. Three Dorr-type HX classifiers
11. Two D20 Krebs cyclones
12. 9x11-ft A-C ball mill
13. Two 8-in. Centriseal sand pumps
14. Two D20B Krebs cyclones
15. Four Dorr 6x33-ft 4-in. x 20-ft dia bowl classifiers. East Sand Plant
16. Two Dorr 6x33-ft 4-in. x 20-ft dia bowl classifiers and one 6-ft x 31-ft 8-in. x 16-ft dia bowl classifier, a Dorr stand-by unit. West Sand Plant
17. East Sand Plant. Twenty-one 44x11½-ft sand leaching vats, capacity 655 tons per vat per charge
18. West Sand Plant. Eight 44x12-ft sand leaching vats, capacity 725 tons per vat charge
19. Dorr thickeners
20. Slime treatment plant. Thirty-one Merrill slime presses, capacity 27 tons of solids per press per charge
21. Merrill-Crowe precipitation units
22. Refinery

How the Slime Plant Works

Operation	Duration	Remarks
(1) Filling	50 to 55 min	Filling alkalinity about 0.5%
(2) Aerating	1 hr 15 min	Effluent to cone tank for later wash and sluicing. Cake packs as filling water drains Charge 0.1 oz gold, extraction 91%
(3) First strong solution	40 min to 1 hr	Effluent strength, 0.045 to 0.050% (NaCN). Gold 0.075 to 0.1 oz per ton. Alkalinity 10 to 12 pts. Gage pressure 23 psi. Effluent clarified—then to precipitation. Barren solution reused
(4) Aerating	30 min	Gage pressure, 28 to 30 psi. Effluent to precipitation after clarifying
(5) Second strong solution	40 min to 1 hr	Gage pressure, 23 psi. Effluent to precipitation after clarifying. Barren solution reused
(6) Aerating	30 min	Gage pressure, 28 to 30 psi. Effluent to precipitation after clarifying
(7) Weak solution	1 hr 30 min 2 hrs.	Gage pressure, 23 psi. First part of this period is leaching period. Latter part actually a wash period. First 1 hr—effluent goes to precipitation, remainder goes to strong solution for strong solution standardization. Cyanide strength 0.03%. Alkalinity 2.2 to 3.0 pts. The length of this treatment period (W.S.) varies considerably. If incoming flow of slime is heavy sometimes as much as 1 hr is taken off at end of this solution period so as to have more presses available for treatment
(8) Wash water	20 to 25 min	Time depends on leaching rate. About 4 tons water used. Effluent also goes to strong solution standardization for reuse
(9) Sluicing period	1 hr 30 min	65 psi. pressure. Residue to waste

How the Sand Plant Works

Typical Sand Plant Charge
660 tons dry weight
Assay—0.175 oz gold, extraction 90%

Operation	Duration (hours)	Remarks
(1) Filling	9	Pulp of 25% solids and minus 16 mesh lime slurry (2.5 lb Lime per ton ore) enter, water filled vat, through Butters-Mein distributor, vat overflow, after clarification reused. Charge 0.175 oz gold, extraction 90%
(2) First drain	18	Effluent to waste
(3) First aeration	16 to 28	Gage pressure, 7½ psi. Effluent value closed. Aeration varied as per alkalinity determination sample during first drain
(4) First strong solution leaching	18	Leaching rate, 2¼ in. per hr. Strength of solution 0.09% (NaCN). Effluent to waste
(5) Second drain	14	Effluent to waste until trace of cyanide, then to solution collector tanks followed by conventional zinc dust precipitation. Barren solution reused
(6) Second aeration	4	Gage pressure, 8 psi. Effluent valve closed
(7) Second strong solution leaching	12	Leachng rate, 2¼ in. per hr. Strength of solution 0.09% (NaCN). Effluent solution to collector tanks and precipitation. Barren solution reused
(8) Third drain	14	Effluent solution to collector tanks and precipitation. Barren solution reused
(9) Third aeration	4	Gage pressure, 8 psi. Effluent valve closed
(10) Third strong solution leaching	14	Leaching rate, 2¼ in. per hr. Strength of solution 0.09% (NaCN). Effluent solution to collector tanks and precipitation. Barren solution reused
(11) Fourth drain	12	Effluent solution to collector tanks and precipitation. Barren solution reused
(12) Fourth aeration	4	Gage pressure, 8 psi. Effluent valve closed
(13) Weak solution leaching (barren solution)	16 to 22	Strength of solution 0.03% (NaCN). Effluent to strong solution collector tanks for standardization to 0.09% (NaCN) and reuse as ongoing strong solution on first, second and third strong solution leaches. Period varied according to amount of wash water used
(14) Washing	17 to 22	Rate, 2⅜-in. per hr. Effluent to strong solution collector tanks for standardization to 0.09% (NaCN) and reuse as ongoing strong solution. Period varied (40 to 50 in.) as per requirement to maintain solution balance
(15) Sluicing	4½	By clarified water through Butters-Mein distributor
(16) Refilling with water	2	Clarified water

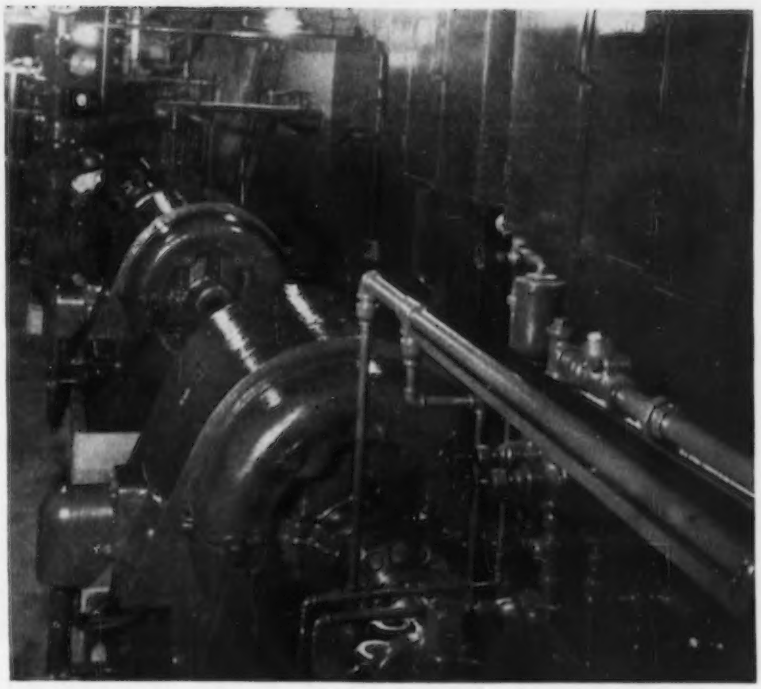
Each of the three 6x12-ft rod mills operating in open circuit is driven by a 200-hp synchronous motor at 19.5 rpm. Grinding capacity per day is about 1350 tons. Ore and water are carried into the mill by means of a special feed spout. The mill uses Lorain rolled plate liners with hardened lifter bars, and the rod charge consists of 2 $^{15}/_{16}$-in. and 3½-in. steel rods. Total liner and rod consumption are 0.055 and 0.5 lb per ton respectively. Liner life ranges from 750,000 to 800,000 tons milled. The liner and rod cost per ton of ore milled is $0.052. Mercury is introduced at the feed end at the rate of 0.175 Troy oz per ton of feed.

The rod mill discharge at about 75% solids goes to a 9x11-ft ball mill driven by a 450-hp wound rotor induction motor operating in closed circuit with a rake classifier. Return sands are conveyed to the scoop box by a 36-in. spiral. The mill operates at a speed of 17.4 rpm. Liners used are Lorain, similar to those in the rod mill, with end liners of moly-chrome steel. About 75% of the ball load is made up of 1¾-in. and 2-in. chilled cast-iron balls, the remainder consisting of 1½-in. alloy or carbon steel forged balls. Total liner consumption is 0.0675 lb per ton, and ball consumption for cast iron and forged steel balls 1.15 and 0.4 lb per ton. The liner and ball cost per ton is $0.115. Mercury is fed to the mill at the rate of 0.275 Troy oz per ton of feed.

Amalgamation

Amalgamation starts in the rod mill, with only a small amount of amalgam recovered periodically from a sump in the mill discharge. The major production comes from the Clark-Todd amalgamator through which the ball mill discharge flows enroute to the classifier. Water jets at moderately high pressure are used to help attain good amalgamation. Amalgam recovery amounts to about ½ oz per ton of ore milled, representing 71.5% of total gold recovery. The classifier operates at 15 strokes per min, and the final product overflows at 16 to 17% solids. Circulating load ranges from 500 to 600%. The degree of grinding done is indicated in the accompanying grinding table.

The fourth mill section employing single-stage grinding consists of a 9x11-ft ball mill driven by a 450-hp wound rotor induction motor at 17.4 rpm and operating in closed circuit with two D20 Krebs cyclones. Ball mill discharge after passing through the Clark-Todd amalgamator is pumped to the cyclones by an 8-in. Centriseal sand pump. The apex valve on the cyclones is 2¾-in., vortex finder 7½-in.



UNDERGROUND PLANT services the Homestake mining operations at Lead.

and pressure on intake header about 6½ psi. Circulating load is 500%. Overflow from the two cyclones is pumped by a second 8-in. Centriseal sand pump to two D208 Krebs cyclones for sand and slime separation, while the underflow returns by gravity to the scoop of the ball mill. These units are operated at 11½ psi, with the apex valve measuring 1⅝-in. and the vortex finder 4½-in. Cyclone underflow represents 58% sand and the overflow 42% slime.

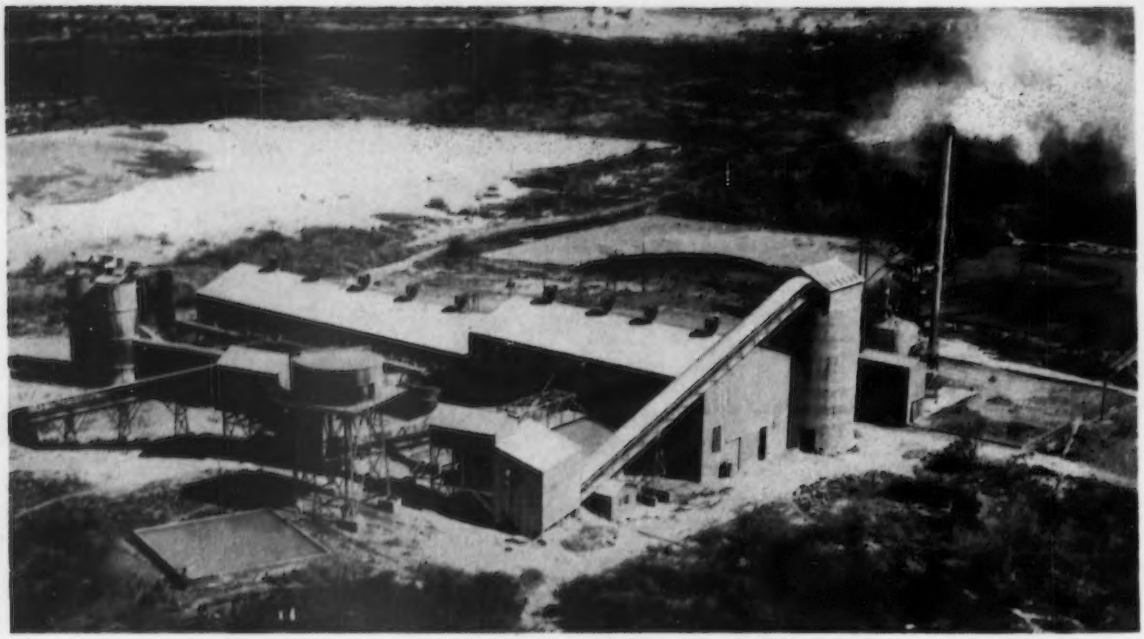
Equipment available in the East Sand Plant for separation of sand and slime consists of 4 bowl classifiers and that in the West Sand Plant of 2 bowl classifiers. The ESP units take the final proluct from two ball mill-classifier circuits and the WSP units that form one ball mill-classifier circuit. Percentage of sand-slime separation made bp the classifiers is 55 and 45 respectively.

Leaching of the sands is done in redwood vats, the bottom of each being provided with conventional lattice framework of pine supporting coco matting and a cover of 10-oz canvas duck immediately above it. Each of the 21 vats installed at the East Sand Plant measures 44 ft in diameter by 11½ ft high, and capacity is 655 tons. In the West Sand Plant, there are available 8 vats each measuring 44 ft in diameter by 12 ft high and holding 725 tons of sand. Filling of vats, discharging leached sands and methods of adding cyanide and lime are standard.

Separated slimes are treated in a separate plant at Deadwood some 3 miles distant from the mill. Equipment here consists of thirty-one 27-ton Merrill presses of the plate-and-frame type, each press having 90 frames, 6x4-ft by 4-in. The 4-in. dimension is the thickness of the slime cake. Plate coverage consists of light muslin twill and No. 10 cotton duck. The twill placed next to the frame provides a cushion for the cotton duck covering it, thereby preventing the stiffer cloth from being forced into the corrugations of the plates. Life of the cotton duck averages 18 months.

In studying the given tables covering the sand and slime treatment cycles, it will be seen that except for the different equipment used, procedure is nearly the same so far as underlying principles are concerned. Precipitation at both plants is done with zinc dust, using the conventional Merrill-Crowe process units. Resultant precipitates and amalgam are refined into gold bullion, 997 plus fine, at the refinery near the South mill.

Ore treated at the mill today assays 0.345 oz gold. Tailings average 0.01 oz gold, giving an over-all recovery of 97%. Power consumptions in kwh per ton are as follows: Rod mills, 2.2; ball mills, 5.2; and all other equipment and lighting in the grinding department, 1.81. Mercury consumption is 0.2 Troy oz per ton milled; cyanide (Aero brand 50% NaCN equivalent) 1.0 to 1.2 lb per ton; lime, 2.4 lb per ton; and zinc dust, 0.02 lb per ton.



TREATING gold ore that was once considered too refractory and too intimately associated with sulphides by FluoSolids roasting makes it possible for Falcon Mines Ltd. to work 4 dwt gold ore at Dalny mine, near Gatooma, Southern Rhodesia.

How FluoSolids Roasting Aids

PHILIP RABONE

PROPER ROASTING of arsenical gold ore in a FluoSolids roaster, combined with a well integrated flotation, cyanidation and tailings scavenging program has resulted in 82.8% gold recovery at a cost of 13s 1.25d per ton treated at Dalny mine.

Dalny Mine is one of a group of four properties controlled by Falcon Mines Ltd. It is 22 miles north of Gatooma in Southern Rhodesia and about 100 miles from Salisbury, capital of the Federation of Rhodesia and Nyasaland. The upper weathered zone was first worked in 1908 for its free gold content, but the mine was shut down when the refractory sulphide ore below was encountered. It was taken over by the present company in 1946.

Orebody is a quartz-impregnated schist containing pyrite and arsenopyrite. Talc occurs in some areas. The ore as mined carries about 4 dwt of gold per ton, most of which is so intimately associated with the sulphide minerals that roasting is necessary to release it. About 15% of the gold is in the quartz as native gold unassociated with the sulphide minerals.

Treatment of the ore was investigated by the consulting metallurgist, J. Coolbaugh of Golden, Colo., in his laboratory at Bulawayo in Southern Rhodesia, and a plant was designed to his specification by Vector Equipment Co., Johannesburg, South Africa, in collaboration with the engineering staff of the mine. Laboratory results were confirmed in a 100-tpd pilot plant which was erected on the property and operated for two years until the full-size plant was brought into commission.

Only Gold Recovered

The latter was started up in 1952 and extended in 1954. Present plant has a maximum capacity of 600 tpd, but the normal throughput is 530 to 540 short tons; i.e., about 16,000 tons per month including a 24-hour shutdown from maintenance and repairs. Gold is the only product that is recovered.

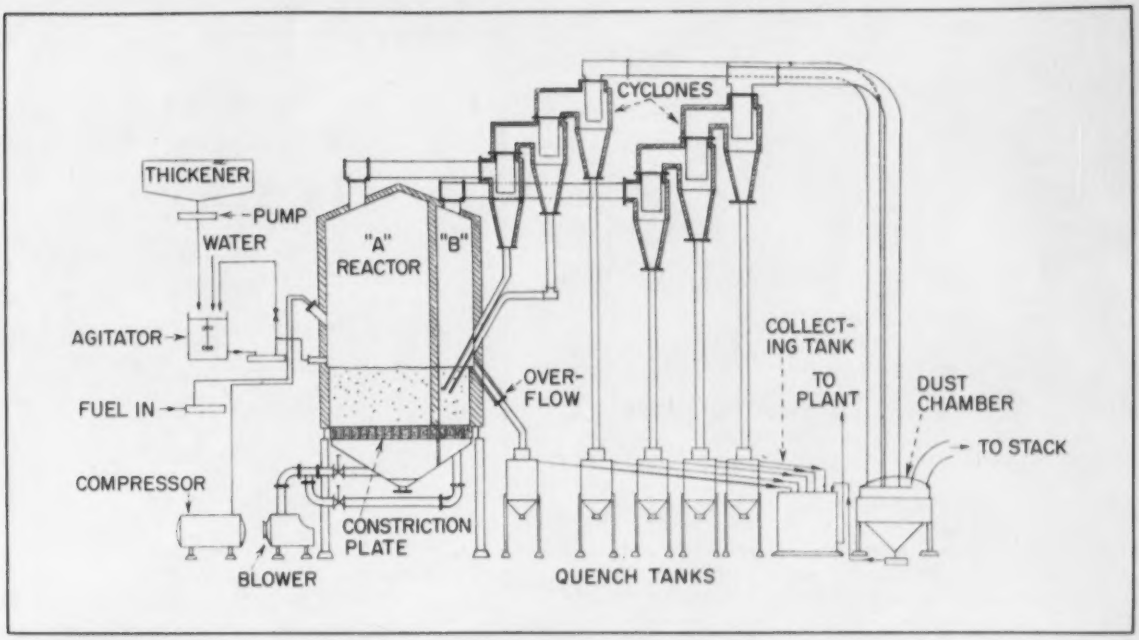
In the initial installation, as completed in 1952, sulphide minerals were concentrated by flotation and sent to the government roasting plant at Que Que, about 100 miles away, for extraction of the gold. Flotation tailing, running 0.7 dwt of gold per ton, was cyanided in Pachuca tanks at the mine, yielding a residue of 0.4 dwt per ton. A FluoSolids roaster was added in 1954 together with a line of Wallace-type agitators, and the flotation concentrate was then roasted and cyanided at the mine.

Flotation was subsequently improved to the extent that the tailing assay dropped to about 0.55 dwt of gold per ton, at which value it became uneconomic to cyanide it. Pachuca tanks were therefore cut out of the circuit and the flotation tailing was sent direct to the slime dam. This circcircuit is shown in the flowsheet.

Subsequent examination of the flotation tailing indicated that it might be profitable to recover the gold in the coarser portion, roughly the 200-mesh oversize, which contains unreleased gold particles but practically no sulphide mineral.

Accordingly, a cyclone was installed over the tailing thickener and provision was made for cyaniding the underflow in the original Pachuca tanks, as shown in the section of the flowsheet marked "new circuit." The cyclone was run to give an underflow containing 1.0 to 1.3 dwt of gold per ton, amounting to 25 to 30% of the tonnage. The overflow assayed about 0.3 dwt per ton and was discarded. 50 to 60% of the gold in the coarse fraction was recovered, but the circuit

Mr. Rabone is with General Electric Co. Ltd., London, England. He is the author of *Flotation Plant Practice* and has been principal professional officer at the government metallurgical laboratory, Johannesburg, South Africa.



CONCENTRATE to the reactor should contain 22 to 24% sulphur, but the reactor can operate with some difficulty on as low as 18% S. Feed rate must be maintained at 1.67 tons of dry concentrate per hour as delivered through a Mono pump.

Gold Recovery at Dalny Mine

proved difficult to operate as the coarse deslimed product tended to settle and pack in the Pachuca tanks and filters.

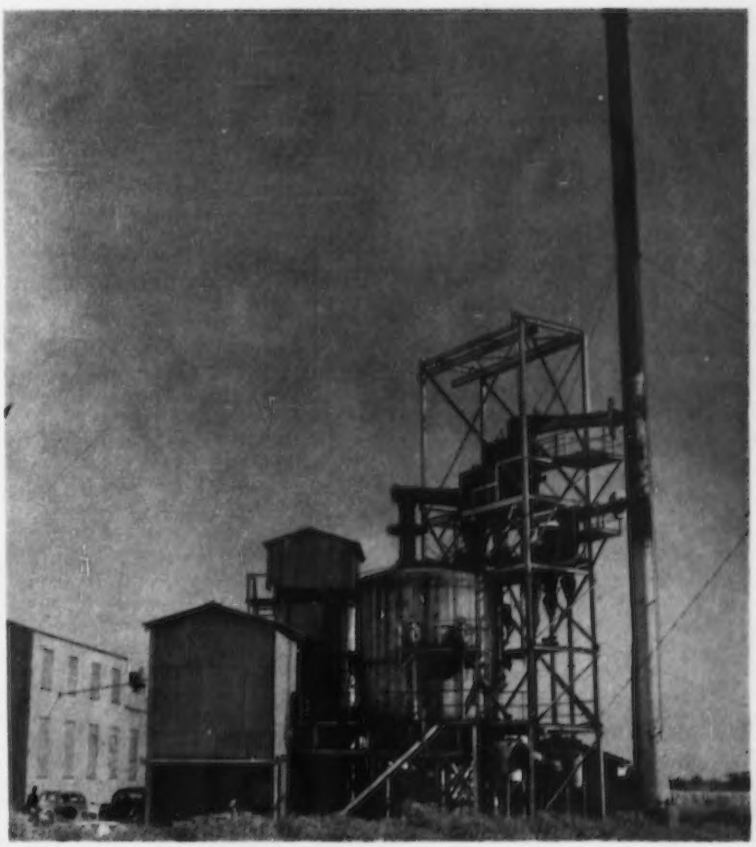
Small-scale tests indicated that regrinding and flotation of the coarse fraction followed by cyanidation of the flotation concentrate should give equally good, if not better, results. There would be no coarse product in the circuit to cause trouble.

Another Change Possible

This method is being tried out, but the circuit has not been finalized and results were not available at the time of writing. The accompanying metallurgical figures and costs refer to the old circuit before retreatment of the coarse fraction of the flotation tailing was started.

Crushers are regulated to give a product for the rod-mill containing 17 to 18% plus ½-in. size; it is never allowed to exceed 20%. With a feed of this size the combination of rod-mill and ball-mill grinds to about 75% minus 200 mesh; see table for screening analyses.

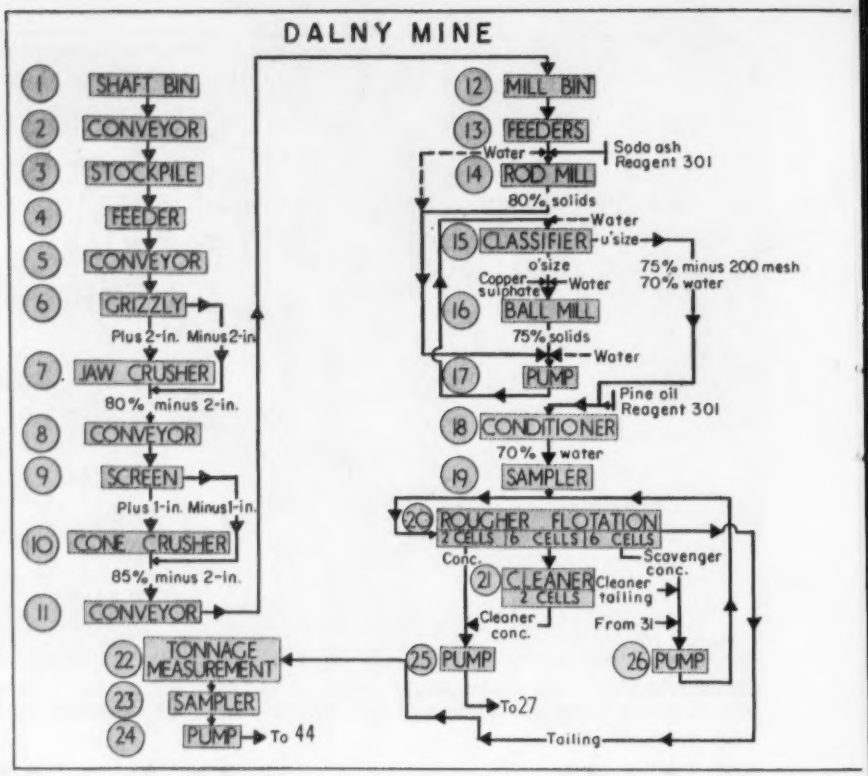
(*Continued on p 102*)



ROASTING sulphide flotation concentrate by FluoSolids method releases the gold after driving off the arsenic.

LEGEND

1. Bin, capacity—50 tons
2. 36-in. conveyor at 150 fpm, capacity—100 tph
3. Stockpile, capacity—550 tons
4. 36-in. Geoffrey-Gallion vibrating feeder
5. 30-in. conveyor at 150 fpm, capacity—80 tph
6. Grizzly, 7-ft 9-in. by 3-ft 6-in.—2-in. spacing
7. 12x30-in. jaw crusher made by Fraser & Chalmers
8. 24-in. conveyor at 250 fpm, capacity—80 tph
9. 3x8-ft Symons rod-deck vibrating screen —⅝-in. spacing
10. 4-ft Symons shorthead cone crusher set to ½-in.
11. 24-in. conveyor at 300 fpm, capacity—80 tph
12. Circular bin 41-ft 6-in. by 30-ft dia, capacity—1,440 tons
13. 24-in. Harding constant-weight feeder; 12-in. Geoffrey-Gallion feeder; and 24-in. belt feeder with adjustable gate
14. 5x12-ft rod mill made by Issels & Son Ltd.; Bulawayo. 23 rpm. 3-in. high-carbon steel rods
15. 5-ft Akins high-weir, duplex spiral classifier made by Vector Equipment Co., Ltd.
16. 8x8-ft ball mill (grate discharge) made by Vector Equipment Co., Ltd. 22-rpm. 2½-in. white cast-iron balls
17. 2x6-in. Wilfley pumps. One standby
18. 8x8-ft Denver conditioning tank. 210 rpm
19. 24-in. Galigher sampler
20. 14-cell No. 36 Agitair roughing flotation machines with Sutorbilt blower, size 8L, 480 rpm, 800 cfm
21. 2-cell No. 36 Agitair cleaner flotation machine
22. Tonnage tank, 10-cu ft capacity
23. 24-in. Galigher sampler
24. Two 4-in. Wilfley pumps. One stand-by
25. Two 2-in. Wilfley pumps. One stand-by
26. Two 2-in. Wilfley pumps. One stand-by
27. 24-in. Galigher sampler
28. Tonnage tank, 10-cu ft capacity
29. Dorr-type, central shaft thickener, 25-ft dia, 8-ft 6-in. high, Vector Equipment Co. Ltd. With 2-in. Dorrco duplex diaphragm pump for circulating pulp
30. Mono pump, No. D-10-D. For feeding stock tank
31. Two cone classifiers, 5-ft dia by 60 deg
32. Stock tank, 8-ft dia by 13-ft 6-in. high, with stirrers at 6 rpm and 20 cfm air at 40 psi for air lift
33. Mono pump, No. D-12 with variable speed drive for feeding to roaster
34. FluoSolids 2-compartment roaster, 16-ft dia by 20-ft high
35. Five quench tanks, 30-in. dia by 4-ft sides with 45 deg cone bottom. Air agitated
36. Two 2-in. Wilfley pumps. One stand-by
37. Cyclone, 10-in. dia, 20 deg cone
38. 4-ft 6-in. Hardinge ball mill on 34 rpm



Numbers in the Legend Apply to Both Flowsheets

39. Two 2-in. Wilfley pumps. One stand-by
40. James sand table, 6-ft deck width
41. Two 2-in. Wilfley pumps. One stand-by
42. Amalgamating barrel, 2-ft dia, 3-ft long, at 34 rpm with four 3-in. dia rods for regrind
43. Amalgamating plate, 5-ft x 2-ft 6 in.
44. Dorr-type central shaft thickener, 75-ft dia, 8-ft 6-in. high. Made by Vector Equipment Co. With 4-in. Dorrco triplex diaphragm pump
45. Two 4-in. centrifugal water pumps. One stand-by
46. Cyclone, 10-in. dia, 20-deg cone
47. Two 3-in. Wilfley pumps. One stand-by
48. Five Pachuca tanks, 15-ft dia by 45-ft high
49. Two Oliver-type drum filters, 14-ft dia by 16-ft long. Fraser & Chalmers, Ltd.
50. Dorr-type central shaft thickener, 25-ft dia by 8-ft 6-in. high. Vector Equipment Co. With 2-in. Dorrco diaphragm pump
51. Two 1-in. Wilfley pumps. One stand-by
52. Seven Wallace-type agitators in series, 12-ft dia by 12-ft high. 2,000 rpm
53. Dorr-type central shaft thickeners, 25-ft dia by 8-ft 6-in. high. Vector Equipment Co. With 2-in. Dorrco duplex diaphragm pump
54. Oliver-type drum filter, 6-ft dia by 7-ft 6-in. long. Vector Equipment Co.
55. 24-in. Galigher sampler
56. Two 1-in. centrifugal pumps. One stand-by
57. Two clarifying tanks, 25-ft dia by 7-ft high, with 3-in. bed of fine sand
58. Merrill-Crowe clarifying leaf filter with twelve leaves, each 12x12-ft
59. Merrill-Crowe de-aerating tower, 6-ft dia by 12-ft high
60. Two 4-in. centrifugal pumps. One stand-by
61. Johnson filter press with 30 leaves, each 3x3-ft
62. Lea recorder for measuring solution tonnage
63. Two barren solution tanks, 12-ft dia by 8-ft high
64. Three 2-in. centrifugal pumps. One stand-by
65. Two 6-in. Wilfley pumps. One stand-by
66. Two 2-in. Wilfley pumps. One stand-by

Compressor—Vacuum Pump Data

Air Compressors

One Broom & Wade compressor, 10.5-in. bore, 12-in. stroke, 50 psi

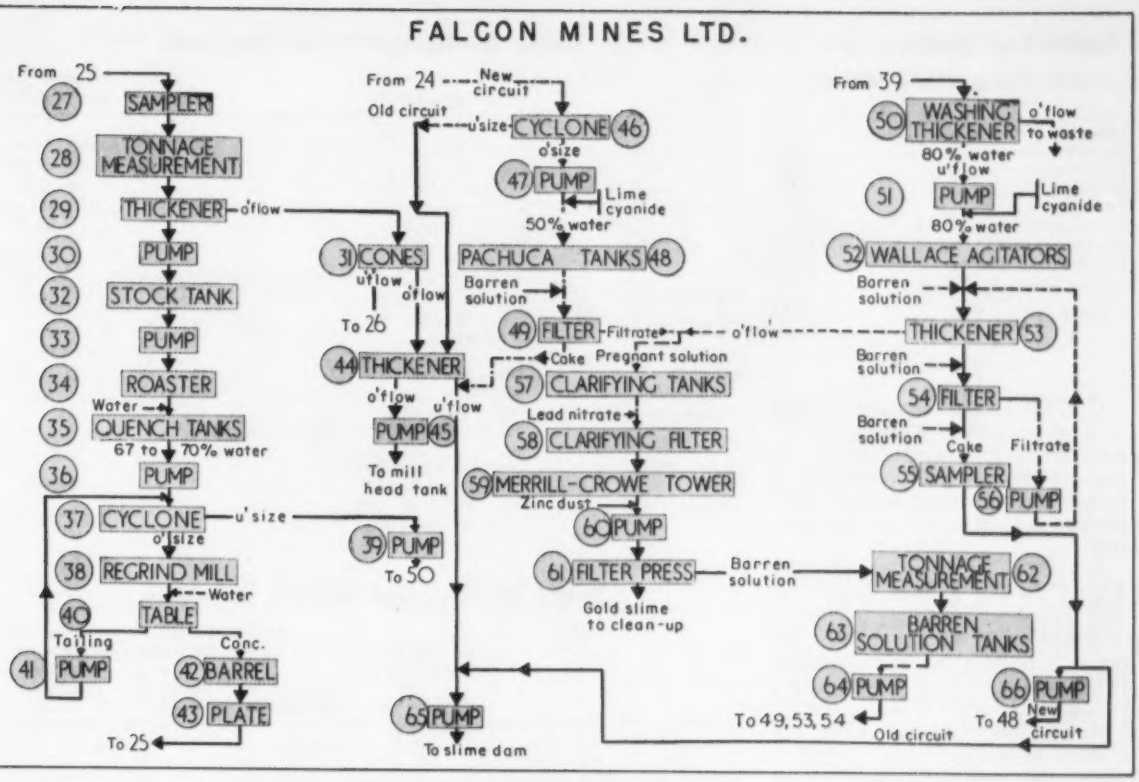
Two Broom & Wade compressors, 6-in. bore, 6.5-in. stroke, 50 psi

Vacuum Pumps

Two Ingersoll-Rand vacuum pumps, 23-in. bore, 14-in. stroke, for the filters

One Worthington-Simpson vacuum pump, 22-in. bore, 9-in. stroke, for the filters

One Oliver United Filter Corp. vacuum pump, 7¾-in. bore, 4-in. stroke, for the Merrill-Crowe tower


FALCON MINES LTD.
From 25
27 SAMPLER
28 TONNAGE MEASUREMENT
29 THICKENER
o'flow
30 PUMP
32 STOCK TANK
33 PUMP
34 ROASTER
Water
35 QUENCH TANKS
67 to 70% water
36 PUMP
37 CYCLONE
u'size
o'size
38 REGRIND MILL
Water
40 TABLE
Tailing
Conc.
41 PUMP
42 BARREL
43 PLATE
To 25
From 24
New circuit
Old circuit
u'size
CYCLONE 46
o'size
47 PUMP
Lime cyanide
50% water
31 CONES
PACHUCA TANKS 48
u'flow
o'flow
Barren solution
To 26
49 FILTER
Filtrate
o'flow
44 THICKENER
Cake
Pregnant solution
57 CLARIFYING TANKS
o'flow
u'flow
Lead nitrate
PUMP 45
58 CLARIFYING FILTER
To mill head tank
59 MERRILL-CROWE TOWER
Zinc dust
39 PUMP
To 50
60 PUMP
61 FILTER PRESS
Barren solution
Gold slime to clean-up
65 PUMP
To slime dam
From 39
50 WASHING THICKENER
o'flow to waste
80% water
u'flow
51 PUMP
Lime cyanide
80% water
52 WALLACE AGITATORS
Barren solution
THICKENER 53
Barren solution
54 FILTER
Barren solution
Cake
Filtrate
55 SAMPLER
56 PUMP
TONNAGE MEASUREMENT 62
63 BARREN SOLUTION TANKS
64 PUMP
66 PUMP
To 49, 53, 54
Old circuit
To 48
New circuit

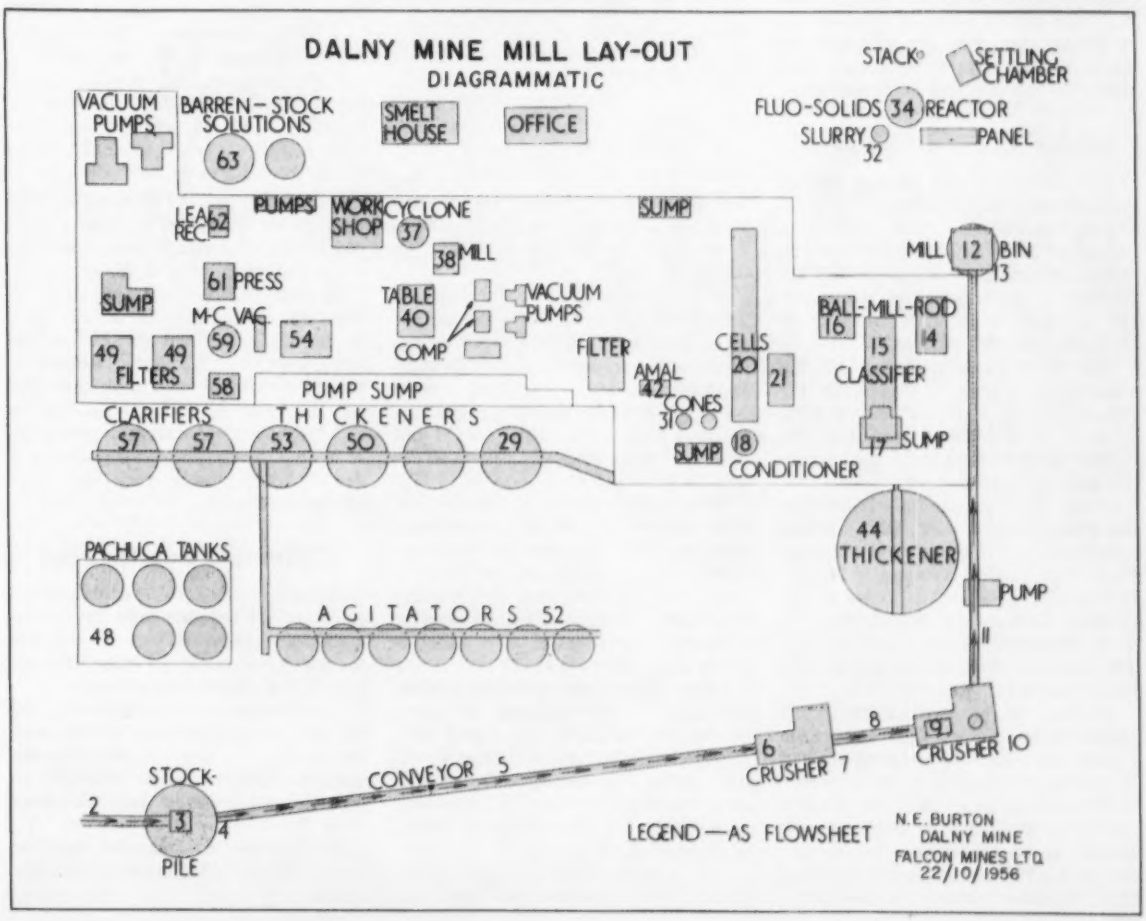

DALNY MINE MILL LAY-OUT
DIAGRAMMATIC
STACK
SETTLING CHAMBER
FLUO-SOLIDS 34 REACTOR
SLURRY 32
PANEL
VACUUM PUMPS
BARREN-STOCK SOLUTIONS 63
SMELT HOUSE
OFFICE
LEAD REC 62
PUMPS
WORK SHOP
CYCLONE 37
SUMP
38 MILL
MILL 12 BIN 13
61 PRESS
SUMP
M-C VAC
59
54
TABLE 40
COMP
VACUUM PUMPS
BALL-MILL-ROD 16
15 CLASSIFER
14
49 FILTERS
49
58
FILTER
AMAL 42
CELLS 20
21
CONES 31
PUMP SUMP
CLARIFIERS 57 57
THICKENERS 53 50 29
SUMP
18 CONDITIONER
17 SUMP
44 THICKENER
PACHUCA TANKS
48
AGITATORS 52
PUMP
11
8
9
CRUSHER 10
6
CRUSHER 7
STOCK-PILE
2
3
4
CONVEYOR 5
LEGEND—AS FLOWSHEET
N.E. BURTON
DALNY MINE
FALCON MINES LTD.
22/10/1956

Table I—Breaking Down the Processing Costs

	Per ton
Conveyors	3.25d
Crushing	1s 0.5d
Grinding	4s 3.75d
Flotation	2s 7d
Cyanidation	2s 8d
Roasting & regrinding	1s 6.75d
Precipitation & clean-up	6.75d
Tailing disposal	1.25d
Total	**13s 1.25d**

Table II—Reagent Consumption

Reagent	Point of addition	Solution strength per cent NaCN	Solution strength per cent CaO	Pounds per ton of feed
FLOTATION				
pH 8.6 to 8.8 Soda Ash	Rod-mill feed			2.0
Reagent 301	Rod-mill feed			0.07
Copper sulphate crystals	Ball-mill feed			0.12
Reagent 301	Conditioner			0.05
Pine oil	Conditioner			0.11
Reagent 301	No. 9 flotation cell			0.02
CYANIDATION				
Aero Brand Cyanide	No. 1 Wallace agitator	0.08–0.1	—	1.0
(NaCN equivalent)				(0.5)
Lime	No. 1 Wallace agitator	—	0.02–0.025	0.3
Aero Brand Cyanide	No. 5 Wallace agitator	0.06–0.08	—	0.1
(NaCN equivalent)				(0.05)
Lead nitrate	Merrile-Crowe clarifying leaf filter			0.003
Zinc dust	Merrile-Crowe precipitating tank			0.03

Table III—Typical Screen Analysis

	Weight per cent			
	Crusher discharge to mill bin	Rod-mill discharge	Ball-mill discharge (flotation feed)	Reground calcine (agitator feed)
Plus ½-in. square mesh	18.0	—	—	—
Plus ¼-in. square mesh	31.5	—	—	—
Minus ¼-in. square mesh	50.5	—	—	—
Plus 10 mesh Tyler	—	23.6	—	—
Plus 20 mesh Tyler	—	20.7	—	—
Plus 200 mesh Tyler	—	42.4	23.0	6.2
Minus 200 mesh Tyler	—	13.3	77.0	93.8
	100.0	100.0	100.0	100.0

Ground product, containing about 70% water, goes to flotation, the circuit consisting of a conditioner and Agitair flotation cells arranged as shown in the flowsheet. Reagent combination is given in the accompanying table.

Secondary butyl xanthate (Reagent 301) is the key reagent, and it has been found advantageous to add at least half of it as far back in the circuit as possible, i.e., to the rod-mil. It is essential to keep the pH at 8.6 to 8.8.

About 10% of the gold is free, and it floats so readily that no attempt is made to recover it on strakes in the ball-mill circuit. Most of it comes up in the first two flotation cells with the more flotable sulphides and is sent direct to the concentrate thickener.

Sulphur Content Controlled

Remainder of the circuit follows normal roughing, cleaning and scavenging practice. The final concentrate averages 22% S and 4.5% As. Its weight varies from 22 to 28 tpd according to the amount of mineral in the ore, and it normally contains 60 to 65 dwt of gold per ton.

The ideal sulphur content for the FluoSolids roaster is 24% but the concentrate is generally nearer 22% S, as it is difficult to keep it at the higher value without some gold escaping into the tailing.

If the ore should contain much talc, the froth becomes thin and the tailing assay rises. This condition is corrected by the addition of dextrine, the quantity depending on the amount of talc present. Concentrate is dewatered in a thickener preparatory to roasting. The disposal of the tailing has already been described.

Previous to the construction of the Dalny Plant, arsenopyrite and pyrite concentrates had always been roasted in Southern Rhodesia in rabble-operated Edwards-type furnaces, usually coal-fired. In order to drive off the arsenic as As_2O_3 without the formation of fusible arsenates, the feed-end of the furnace had to be run at a dull red heat with a gradual rise of temperature along the hearth of 1100 to 1150 deg F in the last section at the discharge end.

If the temperature at the feed-end were too high, as often happened, hot spots developed, due to rapid oxidation of the sulphides, and fusible compounds, mainly arsenates, were formed. These enveloped the gold associated with them, which could not then be released by any practical degree of grinding.

Small-scale tests on Dalny concentrate in a FluoSolids roaster indicated that most of the arsenic could be driven off as As_2O_3 and the sulphur at SO_2 at a temperature of 1090 deg F without the formation of fusible products, the iron in the minerals being oxidized to Fe_2O_4.

Elimination of the remaining arsenic and sulphur with complete oxidation of the iron to Fe_2O_3 required a temperature of 1150 deg F. It was therefore decided to install a 2-compartment FluoSolids roaster in order that each phase of the operation could be controlled.

Size of roaster chosen (16-ft dia x 20-ft high) was somewhat large for the tonnage, but an increase in production was scheduled for a later date. No trouble has arisen from operating it for only part of a day.

In practice, the day's production of flotation concentrate is accumulated in the thickener and pumped to the stock tank over 12 hours. Roaster is started up on the afternoon shift and run for 14 to 16 hours, depending on the tonnage of concentrate produced. It is shut down for the remaining 8 to 10 hours, losing very little heat during that period.

Controlling Roaster Feed

Temperature in "A" compartment is controlled automatically by the injection of water, but to be effective the following conditions must be maintained with reasonable accuracy:—

(1) Concentrate should contain 22 to 24% S. Roaster can be run with the sulphur as low as 18% S, but control then becomes difficult. In practice the grade is kept at about 22% S.

(2) Pulp in the stock tank must be held within the limits of 72 to 78% solids.

Table IV—Steel Consumption

	Tons of ore crushed or ground per liner	Pounds per ton of ore
Jaw crusher		
Jaws	120,000	—
Cone crusher		
Bowl	90,000	—
Mantle	60,000	—
Rod-mill		
Liners	350,000	—
Lifter bars	120,000	—
Rod, 3 in., locally made, 0.9% carbon	—	0.9
Ball-mill		
Shell liners	135,000	—
End liners	180,000	—
Balls, 2½ in., white cast iron, locally made	—	1.5

Table V—Metallurgical Results (1956) Before Retreatment of Flotation Tailing

Product	Gold dwt per ton	Recovery per cent
Flotation		
Feed	4.47	
Concentrate	59.7	88.2
Tailing	0.56	
Roasting		
Feed	59.7	
Calcine	97.5	
Cyanidation		
Feed to Wallace agitators	44.7	
Cyanide residue	3.19	
Recovery of Gold		
Amalgamation of calcine	1.93	43.2
Extraction by cyanidation	1.77	39.6
Total	3.70	82.8

(3) Low-pressure air for fluidizing the beds must be regulated at the following rates: 1,200 cfm (free air) to the wind-box of "A" compartment and 800 cfm to "B" compartment.

(4) Feed must be maintained at 1.67 tons of dry concentrate per hour. A Mono pump with a variable-speed gear gives very accurate control, delivering concentrate through a feed gun into "A" compartment.

Given the above conditions, the temperature in "A" compartment can be held at 1,090 deg F within ten degrees either way by the injection of water. Injector valve is linked electrically to the pyrometer which records the temperature at the top of the bed, a rise or fall in temperature automatically increasing or decreasing the water supply.

Water was originally sprayed direct into "A" compartment, but the feed gun developed a tendency to choke, and the water is now injected into the gun. No trouble has occurred since this alteration was made.

Controlling the Roaster

Instruments required for regulating the roaster are grouped on a number of panels in the control room. They comprise the following:

(1) Foxboro Dynalog temperature recorder and alarm for the top of the bed in "A" compartment; range, 1,080 to 1,100 deg F.

(2) Foxboro Dynalog temperature recorder and alarm for the top of the bed in "B" compartment; range, 500 to 1,200 deg F.

(3) Air pressure gages for regulation of the blowers for "A" and "B" compartments.

(4) Foxboro air-flow recorders for the wind-boxes of "A" and "B" compartments.

(5) Water-flow meter recording the water injected into "A" compartment for temperature control.

(6) Foxboro Dynalog multi-record temperature recorder for the following points:

(a) Bottom of bed in "A" compartment; 1,040 to 1,060 deg F.
(b) Bottom of bed in "B" compartment; 800 to 1,000 deg F.
(c) Wind-box in "A" compartment; 100 to 120 deg F.
(d) Wind-box in "B" compartment; 80 to 100 deg F.
(e) Freeboard in "A" compartment (above bed); about 1,000 deg F.
(f) Freeboard in "B" compartment (above bed); about 760 deg F.

(7) Foxboro Dynalog multi-record temperature recorder for "A" and "B" cyclones with spare connections.

(8) Pressure gages for rotameters for wind-boxes, bottoms of beds, freeboard, and cyclones of "A" and "B" compartments.

Feed Rate Is Critical

The density of the concentrate in the stock tank rises as it empties, and the Mono pump supplying the roaster has to be adjusted to keep the feed tonnage constant. A variation in the feed rate is indicated primarily by the temperature recorders.

If the roaster should be over-fed just beyond the point at which maximum water injection cannot cool it down, the temperature rises rapidly to 1,300 to 1,400 deg F in "A" compartment and less rapidly in "B" compartment. If it is grossly over-fed, the temperature falls in "A" compartment and rises in "B" compartment, and "A" and "B" cyclones may become so hot that the water in the quench tanks boils.

If the roaster should be under-fed, the temperature in "A" compartment rises for a short time and then falls as the charge burns itself out. By watching the temperatures the shiftman can detect over-feeding or under-feeding and adjust the feed rate to the limits within which the temperature can be controlled automatically by water injection.

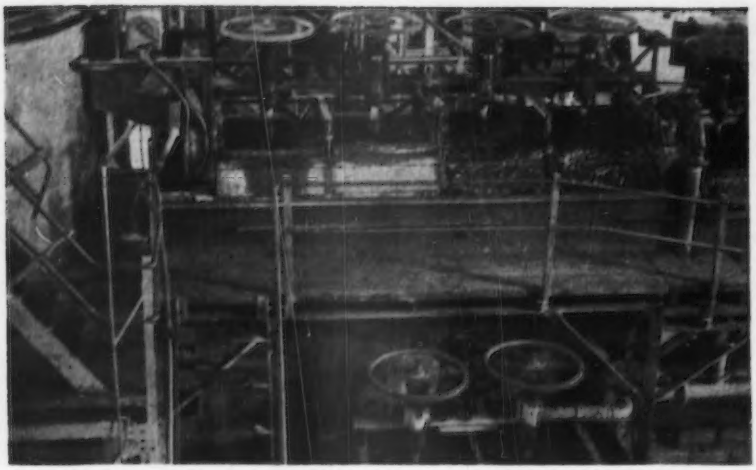
No Gas Control Needed

As a matter of practice it has been established that, for the purpose of liberation of the gold, roasting can be completed in "A" compartment at a temperature of 1,090 deg F., and in the correct conditions, particularly as regards over-feeding, most of the iron oxide can be roasted to Fe_2O_3 at that temperature.

In the Dalny roaster, "B" compartment is run at a temperature of 650 to 850 deg F., and, in fact, its function is no more than that of a cooling and surge chamber.

There seems to be no doubt that fluidization of the bed is so thorough that no hot spots develop in the charge to induce the formation of fusible compounds which would lock up the gold. It is possible that two compartments might be advantageous if control of the effluent gases were necessary; e.g., in the roasting of gold-bearing pyrite for the production of sulphuric acid with subsequent cyanidation of the calcine. At the Dalny plant, however, gas control is of no importance.

The calcine in "B" compartment overflows continuously into quench tanks, from which it is pumped to the regrind circuit. The solids collecting in the cyclones are either returned to "B" compartment or drop into separate quench tanks, as shown in the diagram of the roaster, and even-



CYCLONING the flotation tailings to recover the plus 200 mesh that contains unreleased gold particles raises the total gold recovery in the mill to 88.2%.

OPERATING temperature is held to ten degrees of 1090 deg F in the reactor.

tually enter the calcine regrind circuit.

The arsenic fume that collects in the settling chamber is cleared daily, and the base of the stack is cleaned out once per month. The fume collected carries 24 dwt of gold per ton, and is pumped to the calcine regrind circuit. Calcine runs 1.4% As and 1.0% total sulphur, and contains from about 80 to 100 dwt of gold per ton.

Calcine Reground

From the quench tanks the calcine is pumped at 65 to 70% water to the regrind circuit, where it is reduced to 93 to 95% minus 200 mesh. Circuit includes a James table, the concentrate from which is barrel-amalgamated, about 500 lb being produced daily. It is ground for 16 hours in the barrel with 2 lb caustic soda and 2 lb lime, and for a further three hours with mercury. It is then run out over a plate, and the amalgam, containing about 31% of gold, is collected, stored, and retorted at the bi-monthly clean-up.

Some 40% of the gold in the calcine is recovered in this way.

Ground calcine overflowing the classifying cyclone is collected in a washing thickener, the overflow of which is discarded. Removal of soluble salts in this way is a most important step; without it the consumption of cyanide would be very high and the extraction of gold would suffer. It is proposed to put a Vector filter into the washing circuit—a spare one is available—in order to make washing still more thorough.

Washed calcine is cyanided continuously in a series of Wallace agitators at a density of 20% solids for a total time of about 30 hours. This could be reduced considerably, but, as an increase in capacity is planned, it is not considered worth while to make any alterations; the increase in tonnage will automatically reduce the contact time.

Aero Brand Cyanide, which contains calcium cyanide equivalent to 50% effective NaCN, together with lime, are added to maintain the required solution strengths at the points and in the amounts shown in the accompanying table. Pulp is diluted with barren solution in the thickener following the last agitator, and a heavy wash is sprayed on to the cake on the filter which follows the thickener in order to keep down the dissolved gold loss.

The filter (cyanide residue) contains 3 to 4 dwt of gold per ton, of which 0.12 dwt is dissolved gold. Pregnant solution from the thickener and filter gravitates to clarifying tanks and a Merrill-Crowe unit, where it is deaerated in a Merrill-Crowe tower and precipitated with zinc dust, the gold precipitate being collected in a Johnson filter press.

Smelting the Precipitate

About 300 to 350 tons of solution, containing 3.0 to 3.5 dwt of gold per ton, are precipitated daily, of which 75 to 90 tons are gold-bearing solution from the agitators and the remainder is wash.

Precipitate in the Johnson filter press is cleaned up twice per month. It is dried, fluxed and smelted in a cylindrical rotating furnace with an andalusite lining, which is carried on horizontal trunnions. The furnace is fired by an oil burner through one of the trunnions, flame thus being projected directly on to the charge inside. Furnace has a pouring spout mid-way between the trunnions. Andalusite is unaffected by oxidizing—or reducing—conditions and the precipitate can therefore be smelted direct with an oxidizing flux without the usual acid treatment to remove zinc.

About 250 lb of precipitate are produced every half month. This is mixed with 275 lb of the following flux:

	Per cent in batch
Borax	50
Sand	20
Manganese dioxide	15
Niter	10
Soda ash	5

Half the mixture is smelted first. Slag is poured off the first fusion by tilting the furnace, and the second half-charge is put in through the spout. When the second fusion is complete the slag is again removed, and the gold is then poured into a mould as a single button. This is subsequently remelted in a small oil-fired pot furnace with a little borax and cast into bars, which run 485 to 650 gold and about 200 silver in fineness.

The whole operation is finished during the daylight hours. Mill amalgam is retorted during the clean-up, and the gold sponge is melted in the pot furnace and cast into bars, which have a fineness of approximately 835 gold and 145 silver.

The writer is indebted to E. B. Papenfus, chairman of Falcon Mines Ltd., for permission to publish this article, and to W. D. Hove, manager of the group, and J. Coolbaugh, consulting metallurgist, for their help in compiling it. He would like to acknowledge the willing help given to him by Jock Beveridge, group reduction officer, and R. J. Campbell, resident group engineer.

NEW BOOKS

Survey of Mines 1957. *Financial Post* review of mining activities, companies, metal prices and production in Canada. Tables and maps of mineral areas. Lists activities by Province, region and area. Published by Maclean-Hunter Publishing Co. Ltd., 1242 Peel St., Montreal 2, Que. Available from *Financial Post*, 481 University Ave., Toronto 2, Ont. 392 pp. Price $3.

Kempe's Engineer's Year-Book, 1957. Edited by C. E. Prockter under direction of B. W. Pendred. 62nd edition. Two volumes. Published by Morgan Bros. Ltd., 28 Essex St., Strand, London, WC 2, England. Price 82s 6d, plus postage.

Elements of Engineering Materials, by C. P. Bacha, J. L. Schwalje and A. J. Del Mastro. All engineering materials, including wood, cement, plastics, rubber, soils, metals and lubricants are covered. Text book. Published by Harper & Bros., 49 East 33rd St., New York 16, N. Y. Illustrated in 494 pp. Price $6.50.

Extraction and refining of the Rare Metals. Proceedings of the symposium held at Institute of Mining & Metallurgy, London, March 1956. Twenty-two papers, plus discussion. All these papers were reviewed in New Books, *E&MJ*, May 1956. Published by Institute of Mining & Metallurgy, 44, Portland Place, London, W1, England. Illustrated. 420 pp. Price $8.50.

Uranium Prospecting, by Hubert L. Barnes. Intended for the layman. Previous training is neither assumed nor required. Published by Dover Publications, Inc., 920 Broadway, New York 10, N. Y. Paper-backed. $1.

Machine Tools for Metal Cutting, by W. H. Armstrong. Text book for one semester course for students in technical institutes. Design, time study and production planning in machine shops. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. Illustrated. 340 pp. Price $5.

Chemical Engineering Practice, Vol. III, Solid Systems, edited by Herbert W. Cremer and Trefor Davies. Covers ore dressing, from crushing to finished product, for the chemical engineer. Published by Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. Illustrated. 534 pp. Price $17.50.

Surveying, 2nd edition, by Charles B. Breed. Excellent text on surveying technique and practice. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Illustrated. 484 pp. Price $5.50.

Principles of Engineering Geology and Geotechnics, by Dimitri P. Krynine and William R. Judd. Part of the McGraw-Hill Series in Civil Engineering. Covers geology, solid and rock mechanics and other earth sciences as used by the civil engineer. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. Illustrated. 699 pp. Price $10.

Prospector's Handbook, revised 4th edition. Prepared for the instruction and guidance of all prospectors with special reference to the needs of those men prospecting in Canada. Published by *Canadian Mining Journal*, Gardenvale, Quebec. Illustrated. 400 pp. Price $5.

Operating Ideas for Small Mines, by Koehler S. Stout. Very good little book for the small mine operator and shift foreman. Published by Montana Bureau of Mines and Geology, School of Mines, Butte, Mont. Illustrated. 81 pp. Price $1.

Mining Round the World, stories of mines, minerals and men, by June Metcalfe. Beaverlodge, Eldorado, Shinkolobwe, Pacific Tin, the Colorado Plateau, Broken Hill, Kimberley and the Robinson Deep. Contains bibliography that will provide additional library sources. Well written. Should make a fine gift for the teenager interested in the mining industry. Published by Oxford University Press, 114 5th St., New York 11, N. Y. Illustrated. 117 pp. Price $2.50.

Books presented on this page are available through the publishing house mentioned in connection with the individual literature. *Engineering & Mining Journal* does not sell or offer any literature presented here unless specifically noted.

Reports and Bulletins

17th Annual Report, 1955. Chamber of Mines of Rhodesia Inc. Group activities and production data. Published by Rhodesian Printing & Publishing Co. Ltd., Salisbury, Rhodesia. 40 pp.

South Australia Mining Reviews. No. 99, July-December 1953 and No. 100, January-June 1954. Government Printing Office, Adelaide, South Australia. Illustrated. No. 99—156 pp. No. 100—225 pp.

Australian Mineral Industry, 1955. Review by Department of Natural Development, Bureau of Mineral Resources, Geology and Geophysics, Victoria, Australia. 210 pp. Price 12s.

Equipment Replacement and Depreciation — Policies and Practices. Published by Machinery & Allied Products Institute, 1220 18th St. N. W., Washington, D. C. Price $1.

Metallurgical Works in Canada, Part II, Nonferrous and Precious Metals. Published by Department of Mines and Technical Surveys, Ottawa, Ontario. Price 25c.

Working Press of the Nation. Three volumes listing newspapers, magazines, and radio and television companies, their editors and copy requirements. A must for all public relations offices. Published by the National Research Bureau, Inc., 415 North Dearborn St., Chicago 10, Ill. Ten day inspection period. Price $49.50.

South African Mining & Engineering Year Book, 1956-1957. 44th year of publication by the *Journal*. Published by *South African Mining & Engineering Journal*, Balgownie House, 66 Commissioner St., Johannesburg. Illustrated in 856 pp. Price 63s plus postage.

Supplement No. 4 to Manual of Rock Blasting. Published by Atlas Copco Pacific, Inc., 930 Brittan Ave., San Carlos, Calif. Price $3.

Ontario Mines—Riding the Crest in 1956. Report of the Department of Mines, Ontario. Production data and producing areas. Illustrated. 90 pp.

Statistical Summary of the Mineral Industry, 1950-1955. World production of metal and mineral commodities. Published by Colonial Geological Surveys, Mineral Resources Division, London. Can be obtained in any of Her Majesty's Stationary Offices. 369 pp.

Minerals Yearbook, Area Reports, Volume III, 1953. Published by U. S. Bureau of Mines. Can be obtained through the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Illustrated 1,133 pp. Price $4.

Canadian Mineral Industry, 1954. Review by the staff of the Mines Branch, Dept. of Technical Surveys, Ottawa, Ontario. 254 pp. Price $1.

Statistical Year Book, 1956, Tin, Tinplate and Canning. Published by International Tin Study Group, 7, Carel Van Bylandtlaan, The Hague, Holland.

Critical Materials, Senate Document No. 83. Prepared by the minerals, materials and fuels economic subcommittee of the Committee on Interior and Insular Affairs, 83rd Congress, July 1955. Can be obtained through U. S. Government Printing Office, Washington 25, D. C. 576 pp.

Report of the Commissioner of Mines, 1956, Alaska. Published by Commissioner of Mines, Department of Mines, Juneau. 103 pp.

L'Industrie du Diamant en 1955, by A. Moyar. Published by Antoine Moyar, 54 Rue Royale, Brussels, Belgium. Illustrated. 125 pp.

Annual Report of Under Secretary of Mines, 1955, Queensland, Australia. Can be obtained from A. H. Tucker, Government Printer, Brisbane, Australia. 143 pp.

Control of Radon and Daughters in Uranium Mines, and Calculations of Biologic Effects, by U. S. Department of Health, Education and Welware, Public Health Service. Bulletin No. 494. Sufficient time has not elapsed to permit stating that no American miner has been permanently injured by exposure, but experience in European mines points to a possible increase in the incidence of bronchial carcinoma. Can be obtained through the Department, Washington 25, D. C. 81 pp.

WHAT'S NEW IN U.S. PATENTS

OLIVER S. NORTH

Exploration

Method for measuring electrical potential between points on the earth's surface as a means of locating anomalies that may indicate the presence, at depth, of copper, zinc, or iron sulphides or the like. B. Morrison, assigned to Hudson Bay Mining & Smelting Co. Ltd. No. 2,784,370.

Mining

Sample core barrel design that can pull the core while at the same time having a wash liquid forced through to remove the cuttings that would normally accumulate in a closed-head core barrel. Coring can be accomplished without disconnecting the drill stem, and larger cores than usual can be pulled. H. E. Uhland, assigned to International Minerals & Chemical Co. No. 2,783,969.

Apparatus for making horizontal or inclined bores in a stratum, using liquid or gas jets. Cuttings are removed through a scavenging pipe inside the borehole tube by use of either a worm conveyor or a rear-wardly directed jet. H. B. Fehlmann, assigned to A. G. für Grundwasserbrauten. No. 2,783,972.

Drill bit blade constructed in segments which can be detached when worn and replaced with new parts at a nominal cost as compared with the cost of replacing the entire body of the drilling bit. H. J. Hawthorne and E. M. Weaver. No. 2,783,973.

Design of an expanding reamer to be used with an earth auger to enlarge holes drilled through strata of any type. Reamer is attached to the drill spindle above the auger at an attitude of 180 deg to the digging surface of the auger. F. K. Veasman, assigned to Allis-Chalmers Mfg. Co. No. 2,783,974.

Underground solution sulphur mining method whereby the casing is placed on a line substantially parallel with the line of future probable shifting of strata due to subsidence. Method delays or eliminates casing breaks and results in greater yields of sulphur per given quantity of water. F. M. Nelson and A. F. Zemanek, assigned to Texas Gulf Sulphur Co. No. 2,783,986.

Design for a rock drill of the self-rotating stoper type that supplies water and air through a single tube, rather than through the usual pair of thin tubes. Combined water-air control automatically supplies water when the drill is started and compressed air as the drill is cut down. M. O'Farrell, assigned to Chicago Pneumatic Tool Co. No. 2,783,701.

Mr. North is a patent consultant, Washington, D.C.

Method of increasing output of solution-mined sulphur from a single borehole. At the optimum stage the water is shut off and a sealing material composed of Portland cement and a low-cost oil is injected to form a barrier across the normal path of the water. When the barrier is hardened, solution mining is resumed. Water flows under the barrier to reach additional sulphur-bearing ground. Practice enables more efficient use of the large quantities of water needed. W. T. Ilfrey, assigned to Esso Research & Engineering Co. No. 2,784,954.

An improved muching machine particularly adapted to operate in the restricted space of a vertical or nearly vertical shaft. F. Tofflemire. No. 2,785,813.

COPIES OF U. S. PATENTS can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

Ore Dressing

Electromagnetic apparatus and method for separating magnetic iron and the like from ores containing non-magnetic fractions, using the specific gravity layering normally found on the bottom of a tank containing an ore slurry Selective separation is automatically attained using only the resultant gravity and a low voltage magnetic force. G. Harada. No. 2,783,881.

Concentrating non-silicate, nonmetallic ores such as apatite, fluorspar, langbeinite, phosphate rock and sylvanite in a conditioned pulp on a Humphreys spiral. I. M. LeBaron, assigned to International Minerals & Chemical Corp. No. 2,783,886.

An improved method and apparatus for hydraulic classification of particulate mineral materials, particularly useful for beneficiating phosphate rock, through screening at ¾-in. and putting the undersize through a double column, free and hindered setting classifier. R. D. Evans, assigned to American Agricultural Chemical Co. No. 2,784,841.

An apparatus combining magnetic and electrostatic fields and particularly suited for beneficiating magnetic taconites and similar ores. L. M. Roberts, assigned to Research-Cottrell, Inc. No. 2,786,575.

Hydrometallurgy

Natural brines of the type occurring at Searles Lake, Calif., are treated with slightly enriched flue gas in this process for recovering sodium compounds, sylvite and borax. J. V. Wiseman, assigned to Stauffer Chemical Co. No. 2,784,056.

An improved solvent extraction method for recovering sulphur from sulphur-bearing ores or other minerals. Ore is crushed and immersed in hot solvent. Mixture is treated with water and cooled. Further cooling of the sulphur-bearing solvent causes substantially all the sulphur to precipitate as large crystals, which are then mechanically separated. D. McDonald, assigned to American Sulphur & Refining Co. No. 2,785,059.

An improvement on the Bayer process for alumina extraction in which undissolved sand is classified during the digestion stage in such a manner as to cause substantial amounts of desilication products to form. Practice minimizes the descaling problem usually attending the Bayer process. R. C. Dunn, assigned to Kaiser Aluminum & Chemical Corp. No. 2,785,956.

Recovering saleable manganese directly from nickel-cobalt manganese solutions by adding ammonia and adjusting the solutes content to precipitate manganese. The pH of the residual slurry is adjusted with sulphuric acid to precipitate nickel salts. T. K. Roy and F. A. Schaufelberger. No. 2,786,751.

Pyrometallurgy

Process for recovering chromium from iron ores, such as laterites, in which soda ash or lime is added to the ore and the material mixed and ground. Mixture is pelletized and roasted in an oxidizing atmosphere to convert the chromium content to sodium chromate. Slurry is formed and sodium chromate dissolved out, leaving a low-chromium residue suitable for use as a raw material for producing iron. K. Matsuzaka, assigned to Yawata Iron & Steel Co. No. 2,784,074.

Process for smelting finely divided copper sulphide ores and flotation concentrates. W. E. Greenawalt. No. 2,784,076

Processes for smelting iron and copper ores, such as concentrates obtained by milling and concentrating ores of too low grade to be smelted direct. W. E. Greenawalt. No. 2,784,077 and 2,784,078.

Process for smelting iron concentrates obtained by magnetic or flotation methods. W. E. Greenawalt. No. 2,784,079.

Process for smelting finely divided sulphide copper ores, such as direct milled complex ores and flotation concentrates. W. E. Greenawalt. No. 2,784,081 and 2,784,082.

Apparatus for use in the hydrogen reduction of metallic sulphide ores of iron, lead and mercury. R. Lee, assigned to Lee Foundation for Nutritional Research. No. 2,784,960.

HANDLE WITH ABANDON!

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No "babying" needed here! U. S. Rubber Engineers designed this premium quality hose with more than enough brute strength and stamina to withstand the *highest* working pressures, the *toughest* construction conditions.

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- tube of high quality neoprene is completely resistant to line oil
- special steel wire braid gives tremendous strength, permanent bonding assured by heavy gauge rubber layer
- additional layer of rubber under specially coated rayon breaker protects wire against corrosion should cover be cut or damaged
- cover of carefully selected, tough brown natural rubber fights off injury from rocks, tools, and heavy equipment

Mechanical Goods Division

United States Rubber

PERSONALS

Joralemon

Easton

IRA B. JORALEMON, consulting mining engineer and geologist, has been elected to the board of directors of the Bunker Hill Co., filling the vacancy caused by the retirement of **Stanly A. Easton,** chairman. No new chairman was named. Mr. Easton was named honorary chairman and director emeritus. Mr. Easton had been chairman of Bunker Hill since 1954, and president for 21 years prior to that. Mr. Joralemon has been a mining consultant to the company since 1947.

Robert F. Pettit has been named to the newly created position of chief engineer of American Smelting & Refining Co.'s northwest mining department at Wallace, Idaho. He had been associate professor of mining engineering at the Missouri School of Mines since 1955, and prior to that, was with the Atomic Energy Commission.

Arnold W. Asman, head of the department of mining, Pennsylvania State University, has been appointed product manager of mining equipment sales, Hewitt-Robbins, Inc., effective July 1, succeeding **R. U. Jackson,** assigned to sale of large conveyor contracts and consultation.

Fred Vollmar has been elected president of Apex Minerals Corp., **Carson Frazzini** was named vice president, and **W. B. Naismith** was named secretary-treasurer. New directors named were **Sol Gross** and **Maurice Schulman.**

James V. Thompson has joined Kaiser Engineers as mining engineer-development, at Oakland, Calif. A graduate of the Colorado School of Mines in 1940, Mr. Thompson was with the Baguio Gold Co. in the Philippines, and with Dorr-Oliver Co.

Geno De Rosso, assistant mining captain at Pickands, Mather & Co.'s Cary mine at Hurley, Wis., has been promoted to mining captain at the mine, succeeding the late **Roy R. Smith.**

Harry F. Haller, former assistant superintendent of a limestone property operated by Columbia Southern Chemical Corp. at Barberton, Ohio, has been named superintendent of the Godfrey underground mine near Hibbing, Minn., which Snyder Mining Co. has leased from Oliver Iron Mining Division.

H. Gordon Poole, head of the department of metallurgical engineering at Colorado School of Mines, has been named research and development consultant for Oregon Metallurgical Corp. at their operations in Albany, Ore.

John A. Wood, partner in the firm of Chapman & Wood, mining engineers and geologists, has been elected vice president and general manager of Compania Minera Peralta, S. A. de C. V.

Richard P. Simmons, supervisor of the titanium section of Allegheny Ludlum Steel Corp.'s Brackenridge Works, has been appointed manager of processing of the Toronto, Ohio, plant of Titanium Metals Corp. of America.

Charles W. Yetter has been elected president and general manager, and a director of Capitol Uranium Co. **Fred Carson** was named vice president and **William A. Pope Jr.,** secretary-treasurer.

Joseph Vidmar, welding foreman, has been promoted to master mechanic at Snyder Mining Co.'s Godfrey mine. **Kenneth Coen** has been appointed mining engineer at the mine.

N. P. Arnold, former plant superintendent, has been named master mechanic for the W. S. Moore Co., succeeding **Wilfred Langevin,** retired.

James B. Redpath, executive vice president of Dome Mines, Ltd., has been elected president of the Canadian Metal Mining Association, succeeding the late **Robert R. Brown,** president of Upper Canada Mines, Ltd. Other officers elected were; **J. R. Bradfield,** first vice president; **G. A. LaBine,** second vice president and **F. V. C. Hewett,** treasurer. **V. C. Wansbrough** was reappointed vice president and managing director and **E. C. Newcombe** as secretary and assistant to the managing director.

Redpath

Gordon H. Mayberry has been named to the newly created post of landman for the uranium division of Continental Oil Co. His region covers Colorado, Utah, Wyoming, Montana, Nevada and New Mexico.

Samuel R. Milbank, partner of Wood, Struthers & Co., has been elected a director of the New York & Honduras Rosario Mining Co., to fill the vacancy of **Maximiliano F. Soto,** deceased. **Homer S. Anderson,** resident engineer of the company, has been namd vice president of the subsidiary, Rosario Exploration Co.

John Bley, vice president and general manager of American Chrome Co., Nye, Mont., has ben elected president of the Mining Association of Montana, succeeding **L. E. Burnet,** superintendent for the Montana Phosphate Products Co., who becomes a member of the executive committe.

Al Fritz has been named maintenance enginer of Jones & Laughlin's Mesabi Range operations.

Donald C. Myntti, Oliver Iron Mining Div. mechanical engineer, has been transferred to the Trout Lake concentration plant at Coleraine, Minn., where he will be mill engineer.

United Western Minerals Co., has added three men to its field staff: **Gene K. Ealy,** as director of enginering and geology; **Bobby Gene Donegan,** staff geologist, and **Tom Thorn,** mining engineer formerly with Chapman & Wood.

C. E. Dickens, mine industrial engineer for the Jones & Laughlin Minnesota Ore Division, has been named director of personnel and safety. **L. E. Hodil,** mine industrial engineer at Star Lake, N. Y., was named assistant director.

John E. Bemis, assistant superintendent at the South Agnew mine of M. A. Hanna Co., has been named assistant superintendent of the company's Cuyuna Range district.

William Kinnunen, formerly with Charleson Iron Mining Co., has been named general plant foreman for W. S. Moore Co.'s Mesabi Range mines.

A. F. Savage, assistant superintendent at Plummer mine, Oliver Iron Mining Division, has been promoted to superintendent.

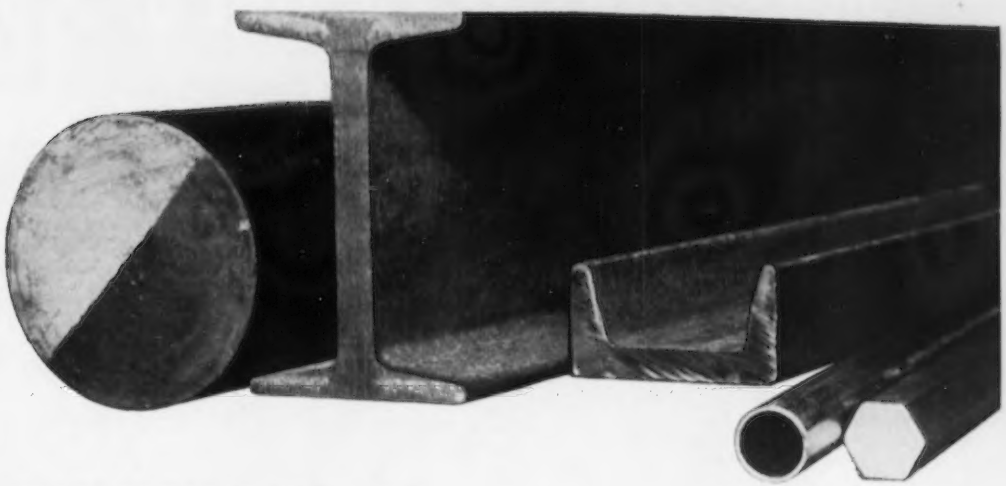
Marshall T. Huntting has been named supervisor of the Washington State Division of Mines & Geology succeding **Sheldon Glover,** who retired.

Thomas Sleeman, master mechanic for Inland Steel Co., has ben transferred from the Bristol Mine in Crystal Falls, to the Sherwood mine at Iron River, Mich., succeding **Harold Sleeman,** who retired.

Robertson

Cohlmeyer

STANLEY H. COHLMEYER has been named project manager, and **Carl W. Robertson,** assistant project manager for the Atlantic City iron ore project located near Lander, Wyo. A mining engineering graduate of the University of Illinois, Mr. Cohlmeyer formerly was project engineer and chief estimator for Western-Knapp Engineering Co. Mr. Robertson was formerly with White Pine Copper Co.



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PERSONALS *(Continued)*

F. A. Linforth, assistant to the vice president of the Anaconda Co., has retired after more than 50 years of service to the organization. Mr. Linforth joined Anaconda in 1905 and following graduation from the University of California in 1906, joined North Star Co. as gold miner. He rejoined Anaconda in 1907 as geologist, and working his way up, became assistant to the manager of mines in 1936, and assistant to the vice president in 1947. He is past president of both the Montana Society of Engineers and the Montana Section, AIME.

Linforth

E. J. Duggan, formerly mill superintendent, has been elected a director of Climax Uranium Co. **A. M. Mastrovich,** general manager, was elected to the post of vice president.

Promotion of employees of the Salt Lake plant, Vitro Uranium Co., included: **Richard N. Miller,** assistant to the president; **Leslie D. Lash,** senior enginer, and **Tony G. Rukavina,** named plant enginer succeeding Mr. Miller.

James L. Lake, Grand Junction, has been named general manager of Union Carbide Nuclear's Colorado Plateau operations, succeding **A. Q. Lindquist,** recently promoted to vice president. Mr. Lake joined Union Carbide in 1952, and was formerly with U. S. Steel Co. and U. S. Vanadium.

Appointment of eight supervisors to key positions in American Gilsonite Co.'s new refinery under construction near Grand Junction was recently announced: **Ray Potts, C. W. Matthews** and **H. H. Gilman,** process foremen; **Kenneth R. Neel,** laboratory foreman; **Richard L. Hoenig,** lead enginer; **Kent J. Jorgenson,** purchase and stores supervisor; **Dale W. Hamilton,** accounting supervisor; **Edward E. Dumont,** maintenance foreman.

Franklin H. Sharp has been named mill superintendent of Sunshine Mining Co., succeeding **Wayne Gould** who resigned to accept a position with Dow Chemical Co.

G. B. Christian, superintendent of American Smelting & Refining Co.'s Frisco Mine until its closure, has been named mine superintendent at the firm's Galena operation. A graduate of Washington State College school of mines, he has been employed by AS&R since 1945.

Parke A. Hodges, vice president of Behre Dolbear & Co., Inc., mining consultants, has been doing professional work in Liberia and Sweden.

James C. Parle has been appointed manager, and **F. F. Todd** and **S. A. Crandall** assistant managers of the newly created Manitoba Division of International Nickel Co., with headquarters in Winnipeg.

Angus D. Campbell, B. A. Sc, of Toronto, has been elected a director of Castle-Trethewey Mines, Ltd., to fill the vacancy on the board resulting from the death of **Col. D. H. McDougall.**

Virgil W. Carmichael has been appointed mining engineer in th Northern Pacific Railway Co.'s Geology Division.

Two new geologists—**Cecil H. Smith** of Salt Lake City and **Ren Demars** of Brigham City, Utah—have joined the staff of Vitro Minerals Corp. in Riverton, Wyo. Mr. Smith was named division geologist succeeding **David Welsh,** resigned.

Alfred Ellerby of Lander, Wyo., has been re-elected president of Vipont Mining Co. **William Morey** of Riverton and **Virgil Abbot** of Lander, were re-elected to the board of directors. Two new directors added are: **Daniel F. Svilar** and **O. Milton Dalley.**

Brady C. Lee has been named chief accountant and mines assessor, and **Harold G. Matthews** as assistant chief accountant of the Ontario Department of Mines.

Kaiser Engineers' Development Division has announced that **A. A. Wallach,** copper mining and ore processing specialist, has joined the company as one of the division's principal engineers, responsible for project analysis in the fields of mining and quarrying, ore processing and non-ferrous metals. For the past two years before joining Kaiser Engineers, Mr. Wallach was chief metallurgist for the San Manuel Copper Corp. Prior to that he was with the Magma Copper Co. as chief metallurgist.

Wallach

Donald Virant, mining engineer, Pickands Mather & Co. is now chief engineer for the Hilton Mines at Shawville, Quebec.

Peter J. Peterson, master mechanic at the Montreal, Wis., mine, has retired. He had filled that position for about 30 years.

Douglas Brown, of Inland Steel Co.'s main office at Ishpeming, Mich., has been appointed mine engineer at the company's Sherwood mine at Mineral Hills.

Tom Tweed, recently released from Army service, is now on the Inland Steel Co. engineering staff at Ishpeming, Mich.

David S. Coyle, metallurgical engineer, is now with the Cleveland-Cliffs Iron Co.'s research laboratory.

Geologists **Warren R. Wagner,** Boise, Idaho, and **Russell C. Cutter,** Grand Junction, Colo., have formed a consulting service for general exploration, marketing and supply, property evaluation, acquisition and development, airborne geological and geophysical surveys.

Robert Annan, chairman of the Consolidated Gold Fields of South Africa, Ltd., has been named 1957 recipient of the Egleston Medal, Columbia University's highest award for "distinguished engineering achievement."

John Q. St. Clair, consulting mining geologist, has announced the opening of offices in Albuquerque, N. M., at 406 San Mateo, N. E.

HUNGARIAN WORKER SIGNS IN. Charles Komar, 27, one of six Hungarian engineers recently recruited by the Bunker Hill Co., signs employment papers at the mining and smelting firm's Kellogg, Idaho, office. Looking on are his wife (right) and a member of the employee relations staff. Mr. Komar is a mechanical engineer. Bunker Hill was one of first firms to tap employment pool created by recent influx to the United States of Hungarian refugees.

It pays to take a "SECOND LOOK" before you buy a 1½-cu. yd. tractor-shovel!

Compare the "Big 4" for yourself!

Feature	TerraTrac® 800	Mfr. "A"	Mfr. "B"	Mfr. "C"
Bucket Capacity (Mfrs. rating)	1½ cu. yd.	1½ cu. yd.	1½ cu. yd.	1½ cu. yd.
Engine HP (Net)	72 (80 Gross)	70	66.5	71
Torque Converter	YES	NONE	NONE	NONE
Max. lbs. push or pull, assuming adequate traction	20,000	Not Published	15,170	12,600
Forward Speeds, MPH	(4)0 to 6.0	(4)1.7 to 6.9	(4)1.5 to 5.5	(4)1.9 to 6.3
Reverse Speeds, MPH	(4)0 to 7.0	(2)1.9 to 3.0	(2)2.0 to 4.1	(2)2.1 to 3.9
Transmission	HYDRAULIC POWER-SHIFT	MANUAL CLASH-SHIFT	MANUAL CLASH-SHIFT	MANUAL CLASH-SHIFT
Steering (1) (2) (3)	Brake-Turn Power-Turn Counter-Rotation	Brake-Turn NONE NONE	Brake-Turn NONE NONE	Brake-Turn NONE NONE
Track Frame Oscillation	YES	NONE	NONE	NONE
Dump clearance at max. discharge angle	9'1"	8'3¾"	8'0"	8'0"

Above information based on latest specification sheets available to us at time of printing.

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FIRST in quality for over 100 years

Clip...mail for more proof

Maybe you didn't realize it! But it's a FACT ... there's as much difference *performance-wise* between the new 1½-cu. yd. Case® TerraTrac 800 — and conventional crawler rigs — as there is between a modern *power-operated* automobile, and the old-style *"clutch-and hand-shift"* machines of 10 years ago.

Part of this difference you can see *"on paper"* — in the accompanying chart. But the real difference comes *"on the job"*, where the extra power, speed and maneuverability of the Case TerraTrac 800 is enabling owners to move up to *40% more yardage per shift.*

Compare the "big-four" for yourself. Then mail the handy coupon below, so your Case Industrial Dealer can arrange a *free* Terra-Trac 800 demonstration on *your* job — soon!

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PERSONALS *(Continued)*

Norman E. Wycoff has been named foreman at Reserve Mining Co.'s taconite plant maintenance department at Silver Bay, Minn.

Louis Samsa, underground foreman, Oliver Iron Mining Div.'s Chisholm-Hibbing district, has retired after 47 years of service with Oliver.

Domenic Costanzi has been promoted to master mechanic at the Webb mine, Snyder Mining Co., succeeding **Alva A. Erickson,** advanced to mechanical superintendent at the company's Mesabi Range mines.

John L. McGara has been named president of Yuba Consolidated Gold Fields, and its subsidiaries, Yuba Manufacturing Co. and Portuguese American Tin Co. His appointment followed the resignation of **B. F. Pitman Jr.,** Texas financier who won the presidency after a proxy fight last year. Mr. Pitman remains on the board of directors. **Ernest J. Gorman,** vice president and general manager who retired last year, is now consultant on mining operations and secretary of both Yuba Consolidated and Portuguese American. **Richard H. Keatinge** has resigned as vice president and secretary of Yuba Consolidated, vice president of Yuba Manufacturing and vice president and secretary of Portuguese American.

McGara

OBITUARIES

Stanley A. Odlum, 41, vice president of Atlas Corp., and son of Floyd B. Odlum, died suddenly at Mount Sinai Hospital, New York, March 15, after a brief illness.

Isaac Van Horn, 91, former editor and publisher of the **South East Miner,** and secretary-treasurer of the North Carolina Magnesium Development Corp., died March 13 in Asheville, N. C.

John C. Andersen, 36, and **Benno Wasserstein,** 50, employed by Kaiser Aluminum & Chemical Corp., were killed in an airplane accident in Central America, December 12.

C. D. King, assistant to the executive vice president-operations, for U. S. Steel Corp., died March 24 in Pittsburgh. He joined the company in 1914 as a metallurgist at the Clairton, Pa., Works

Axel M. Peterson, 82, mining consultant, died March 13 in San Francisco. Until his retirement at the age of 76, Mr. Peterson was active in exploratory work in Central and South America. In the 1930's he was associated with Placer Development, Ltd. Following World War I, he went to the Malay Peninsula and helped organize Pacific Tin Consolidated to develop alluvial tin deposits.

William Lisle Parish, 60, mining engineer in the Duluth general offices of Pickands Mather & Co., died January 2 at his residence in Duluth. Prior to joining Pickands Mather in 1923, he was employed as mining engineer with the Oliver Iron Mining Co. in Hibbing.

Richard J. Woods, 42, purchasing agent for Reserve Mining Co., died January 25 at Cincinnati, Ohio, following a prolonged illness. A veteran of 25 years of service with Armco Steel Corp., he joined Reserve 4 years ago. He made his home in Silver Bay, Minn.

Conrad F. Trowbridge, 54, assistant general manager in charge of Erie Mining Co.'s taconite construction plans, died March 15 in Duluth, Minn. He engineered and constructed Erie's big plant near Aurora, including railway, dock and harbor.

Allan E. Craig, 65, metallurgical engineer for Mine & Smelter Supply Co. of Denver, died April 7 after a short illness. He was past president of the Colorado School of Mines Alumni Association, and a member of the AIME.

LETTERS

Oxidized Copper

Dear Sir:

Could you please send me a copy of the entire article on Oxidized Copper?

In checking over Part III, I found one thing rather confusing. The table of costs on p 81, March *E&MJ*—the breakdown costs—when added up does not equal the figures for total cost. Is there a column missing?

F. J. Garbutt
Toronto, Canada

• The column total cost should have read—Total cost includes overhead and local taxes.—Ed.

Follow-Up on Dowa

Gentlemen:

As a follow-up on your article "How Dowa's Plant Extracts Cu-Zn From a Single Electrolyte," *E&MJ*, January 1954, pp 72-74, I thought you might be interested in developments at Dow Mining Co. Ltd. since that date. As you know, Dowa started to recover copper and zinc from a single electrolyte in November 1952. We have had four years of continuous success. There is nothing more to doubt. The Dowa process works. A sulphuric acid plant was constructed by Chemical Construction Corp. in November 1956 with another Dorr FluoSolids roaster for roasting zinc sulphide to get high SO_2 concentration and a higher zinc recovery. Results to date have been excellent. Average monthly data from April to September 1956 are as follows:

Production	Tons per month
Electrolytic copper	149.9
Electrolytic zinc	279.6
Electrolytic cadmium	1.1
Sponge copper (72% Cu)	88.9

Also I might add that in Japan we have many pyrrhotite deposits. However, it has not been much used as iron pyrite. Our successful sulphatizing roasting of copper sulphide in the Dorr FluoSolids reactor led me to think of further application of the same reactor to pyrrhotite in order to produce sulphuric acid and iron ore and copper.

We started the Okayama plant in September 1953 to produce 3,000 tons of H_2SO_4 (98%) and 2,500 tons of iron ore (62% Fe) a month. After a successful start-up, another roaster was added to double production. Recently monthly production data are as follows:

Production	Tons per month
H_2SO_4	5,904
Iron ore (62%)	4,920
Cement copper	59.4

A further development in leaching copper from pyrite cinder was started by Dowa at my suggestion. Dowa Mining Co., Ltd. make a copper leaching plant from pyrite cinder at Amagasaki (between Osaka and Kobe) and bought a big portion of the stock of Amagasaki Iron & Steel Mfg. Co. We restarted one blast furnace, which was damaged by an air raid in the final stages of World War II, in order to show that iron pyrite cinder would make a good iron ore.

The blast furnace was started in April 1953. After 3 years of success, we have enlarged the capacity of the leaching plant from 10,000 to 20,000 tons per month. My object to demonstrate the use of pyrite cinder was satisfied and by the request of Kobe Seiko Co. (Kobe Steel Works, Ltd.), one of the biggest steel and heavy machinery makers, we ceded the stock of Amagasaki Iron & Steel Mfg. Co. Ltd. to Kobe Seiko Co. The blast furnace is operated by Kobe and we supply them with copper-free pyrite cinder—iron ore.

Recent production figures (October 1956) are as follows:

Production	Tons
Iron ore	12,926
Cement copper	49.3

As of January 1957, production will be doubled. My dream to have a copper mine in the industrial city of Amagasaki was realized. A production of 60 tons of copper per month means a pretty big mine in Japan.

N. Kurushima
Dowa Mining Co. Ltd.
Amagasaki, Japan

You can depend on the EDISON R-4's brilliant, unfailing light...

The Bulb's reserve filament means continued, full light

See the double filament in the bulb. It's your proved protection against lost time for the miner, and a short crew for the foreman. If one filament burns out, a turn of the switch restores continued, brilliant, full illumination—*working light*, not just emergency light!

The battery that doesn't fail on the job

Because light is only as dependable as the battery that provides the power, battery service life is the only answer to performance. The Edison R-4 Battery does not destroy itself to function, does not deteriorate when not in use. You get the most dependable light, shift-after-shift, for years.

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Your Edison lamp installation—Self-Service, Standard or Modified—is the responsibility of a trained M.S.A. Service Engineer. His planned system of return calls insures your receipt of the maximum service from your lamps. You benefit from this responsible know-how in peak lamp performance, more efficient and economical lamphouse procedure.

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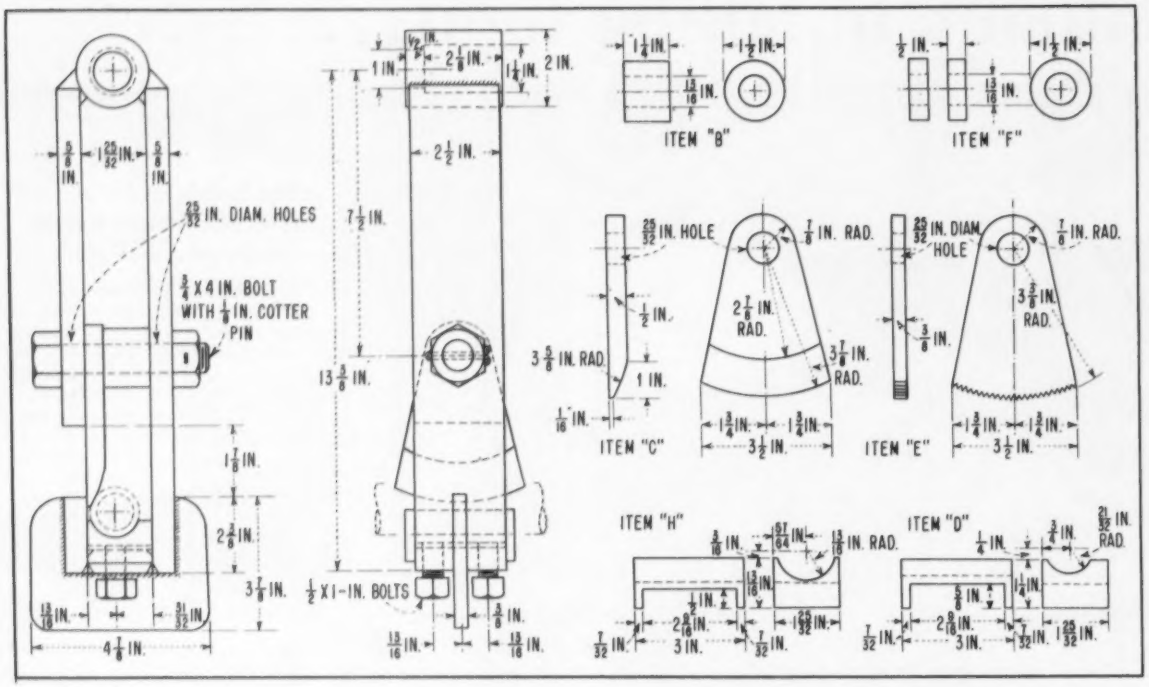
These Edison R-4 QUALITY features, and service, give you that *extra* illumination that lets you realize every production advantage from today's mechanized equipment. Let us show you how this vital mining tool can help fill the gap between average and peak production with greater safety. Write for details.

OPERATING IDEAS



Rigid Arm Diamond Drill Rod Puller Has Advantages

CAM-TYPE RIGID ARM rod puller has been designed to eliminate disadvantages of conventional knife-dog for pulling or pushing diamond drill rods out of or into a drill hole. Device and its designer, G. B. Coghlan of Zinc Corp. Ltd. and New Broken Hill Consolidated Ltd., Broken Hill, New South Wales, Australia, are shown in photo.

It is bolted rigidly to end of piston rod of double acting air cylinder. As compared to usual knife-dog suspended by series of ring links from end of piston rod, new device requires much shorter travel of piston before parts lock onto rods. Bending of piston rod, a very frequent trouble with knife-dog pullers, is entirely eliminated and wear on cylinder pistons and gland packings is very greatly reduced, it is claimed.

Length of rods which may be moved with this device is limited by force available from pneumatic cylinder and varies, of course, with size of rod, depth, inclination and cleanliness of drill hole as well as air pressure available.

In use, puller is placed over string of rods through open portion in one side piece. Rods lie in U-grooved saddle.

For pulling rods, while puller is being placed on rods, wheel segment is swung away from collar of drill hole. This is done so that wheel segment will slide along top of rods as puller is moved toward hole collar by piston. On return stroke, wheel segment tends to turn toward hole collar, cam down and thus grip rod between itself and saddle. Once gripped, rods follow movement of piston and move out of hole.

When placing rods into hole, wheel segment must be swung toward collar of hole before rods are placed in saddle. Then as puller is moved toward hole collar, segment swings down and grips rods.

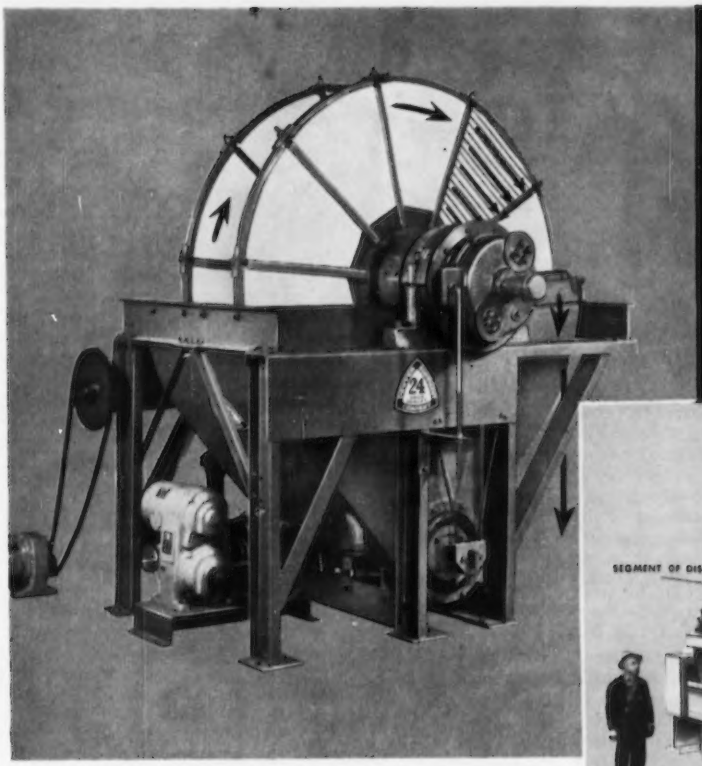
Construction drawing shows slightly different model than photo. In drawing, wheel segment has wedge-shaped camming surface. In photo, toothed wheel segment is shown. These parts (Item C and E, respectively) are shown in more detail on right side of drawing. Wedge wheel needs single ferrule or spacer (Item B) on bolt axle. But toothed one must be centered on axle with two ferrules (Item F). Rod contacting surface is case hardened to 1/16-in. on both types. Serrations on Item E are 1/16-in. deep and pitch (spacing) is 1/16-in.

Two sizes of saddles are used to accommodate either A or E drill rods. Item D (shown inserted in arm in drawing) is used for E rod (1 5/16-in. dia)

and item H is used for A rod (1 5/8-in. dia). Adjusting or set screws in bottom of arm permit fine adjustment.

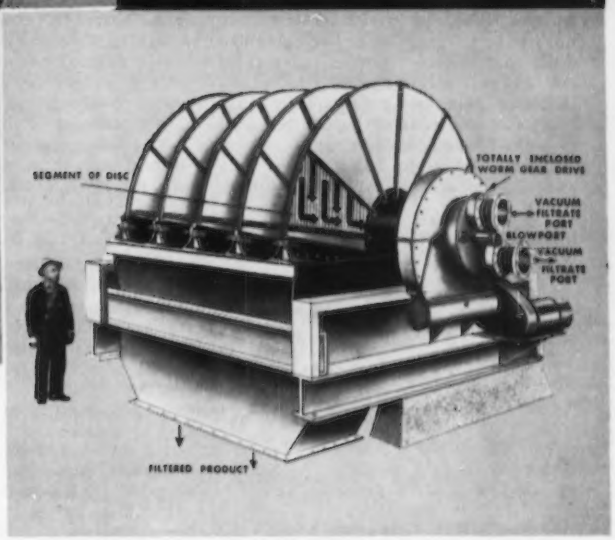
Mild steel plate and bar stock is used throughout. Bolts are standard type. and double acting air cylinder is controlled by four-way valve.

WANT MORE GOOD OPERATING IDEAS? We do. Send us yours. No sweat, just a rough sketch or photo plus memo on advantages, application and fabrication. We redraw and rewrite. And we also reward authors of those we can use. (More Op Ideas on next page)



NEW!

NEW!



DENVER Agitator-Type DISC FILTER

Has New, Simple Agitating Mechanisms

...offers increased filtration capacity and reduced moisture content—PLUS a simple agitation mechanism. NO PACKING GLANDS to cause expense and delays. Proper tank agitation is supplied to keep solids in suspension for even cake distribution of filter sectors.

NEW, patented DENVER agitation mechanism eliminates need for submerged bearings, packing glands or sealing water. Contamination from grease or sealing water is completely eliminated. Maintenance is minimum. Agitating mechanism can be removed easily as unit. Write for bulletin F9-B5.

ROBERT E. HANCOCK, DECO Sales Engineer, is a graduate Metallurgical Engineer with many years of valuable experience. He will be glad to work with you on any filtering problem and send you recommendations based on sound engineering.

12-Sector Disc Design on 9′ DENVER Filter

Means EXTRA Filter Capacity

There are 12 sectors per disc on the 9′ DENVER Disc Filter as compared to only 10 sectors normally used. Vacuum is effective through greater portion of filter cycle. It is applied sooner after cake discharge and retained longer before cake discharge.

Patented gravity drainage grooves in filter sector remove residual moisture by gravity and prevent blow-back of moisture before cake discharge giving drier product. Available with Patented Tank Agitator.

Every Engineer planning a new filter installation will want to study the design, specifications and distinctive features of DENVER filters. Bulletin F9-B4 will be sent on request.

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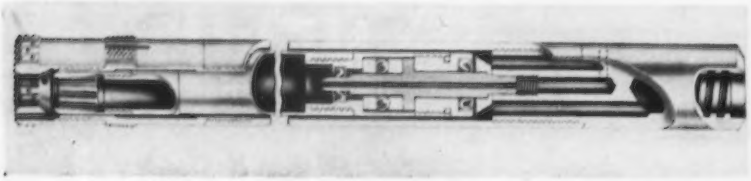


INNER TUBE for Series D or any other core barrel can be chrome plated.

Chrome Plated Tubes Improve Coring

BY CHROMIUM PLATING the inside surface of standard inner tubes for diamond drill core barrels, several advantages are gained, according to Christensen Diamond Products Co., Salt Lake City, Utah. Chrome tubes are especially useful in hard, abrasive, broken rock.

Field data, given below, prove two advantages: longer runs and longer inner tube life. These plus other performance reports clearly indicate additional and related improvements: faster drilling, greater footage per shift, lower barrel costs, increased core recovery and less disturbance of core.

The following results were in badly broken quarzite, porphyry and limestone at a large Western U. S. copper pit:

LENGTH OF RUNS

Standard 5-ft inner tube

Length of runs (ft)	Number of runs	Percentage of runs
1	6	30
2	7	35
3	2	10
4	3	15
5	2	10
Totals 48	20	100

Average 2.4

Chrome plated 5-ft inner tubes

Length of runs (ft)	Number of runs	Percentage of runs
1	20	10.6
2	38	20.1
3	49	25.9
4	17	9.0
5	65	34.4
Totals 635	189	100.0

Average 3.36

Comparison: 40% longer runs with chrome plated inner tube.

INITIAL COSTS & LIFE

Standard 5-ft inner tube: $20; about 100 ft. Equivalent to $0.20 per ft.

It was estimated by the foreman on the job, that standard inner tubes are retired from use after approximately 100 ft. When retired, they are badly worn and dented out of round due to pounding with wooden clubs which is necessary to remove the core from the tube.

Chrome plated 5-ft inner tube: $36; over 300 ft. Equivalent to $0.12 per ft.

The first chrome plated tube was used for approximately 185 ft before it was re-machined by Christensen Diamond Products and turned end for end. This was done because the chrome had started to peel at the bit, causing core blocking and consequent short runs. After the change, it was used for an additional 150 ft and then retired. Total footage with this barrel was 335 ft.

The second chrome plated inner tube had cut 300 ft and was still in use at time of report.

Comparison: Cost per foot for chrome tubes is about ¾ that of standard tubes.

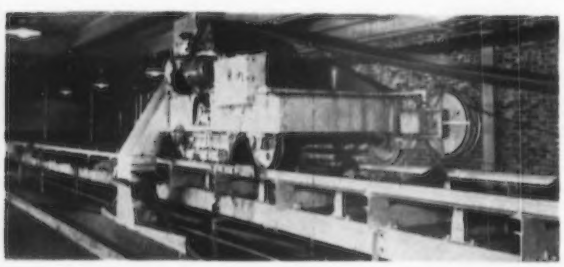
For years, diamond drill operators and mining companies alike have looked upon hard, broken, abrasive rock with fearsome respect. To mining companies, this type of rock has meant poor core recovery which results in a lack of information vital for the geologist to determine location, extent and grade of orebodies. To drillers, this rock has meant short runs, poor core barrel life, constant blocking, core grinding, very slow progress and thus high drilling costs. Such was problem to solve.

Two factors are believed to lie at the root of this problem. First of all, the surface of any piece of steel tubing is somewhat rough unless it has been honed. Secondly, most rock with a high percentage of silica has a greater hardness than seamless steel tubing. Thus the very slight irregularities and softness permit a broken fragment of core to wedge and the other core to dig-in. This causes blocking and heavy wear on the surface of the tube. While this block remains in the tube, any core cut by further drilling is ground and lost.

Now, the application of chrome plating results in a smooth and very hard abrasive-resistant surface on the inner tube. This surface allows the core to enter freely and reduces to a minimum the tendency of the core to block. Consequently longer runs and a marked increase in core recovery results.

Not only does core slip from the chrome plated surface more easily but also denting by wooden clubs has virtually been eliminated because the plated tubes are made from heavier tubing.

CORING RIG at work in copper pit.



Cable Reel Used On Tripper

REEL RATHER THAN EXPOSED TROLLEY WIRES transmits power to traveling tripper on belt conveyor at Indianapolis Power & Light Co. plant, Indianapolis, Ind. Unit handles coal. Reel is from Gleason Reel Corp.; installation by Link-Belt. Device holds cable taut. Dust seal at dump point is noteworthy too.

ON THE go

by J. Hall Carpenter

IN AUSTRALIA, on February 15, Australian Oil Exploration, Ltd. reached full design capacity in the production of rutile from their plant at Mermaid Beach. Visiting this plant with our Brisbane engineers, we were pleased to find that although the plant had been erected in only nineteen weeks, it was in full production within one week from the start-up date. This is another plant equipped with Carpco high tension and magnetic separators.

DUAL FLOW ROTARY DRYERS, the latest addition to the Carpco line, have been found to be of interest to production men in mining, chemical and construction industries. These newly designed dryers are highly efficient and compact, providing indirect heating by radiant means and direct heating by the hot gases. They are designed for drying granular materials with no loss of fines. Two models are available: One and two tons per hour capacity (based on sand fed at 10% moisture). Bulletin RDB-101 gives the particulars.

ENGINEERING SERVICE IN MALAYA AND THAILAND will be further strengthened by Roy Barrow, Guthrie engineer, who is now in Jacksonville for advanced training in our latest ore dressing techniques and to familiarize himself with our latest equipment developments.

"HIGH VOLTAGE AND MAGNETIC SEPARATION" is the title of the paper which was prepared for the American Mining Congress convention in Los Angeles in October 1956. This paper was published in the March issue of "Mining Congress Journal." It reviews high voltage and magnetic separation techniques as presently used in ore dressing and puts special emphasis on the technical difference between electrostatic and electrodynamic separations. Reprints of this paper can be had upon request.

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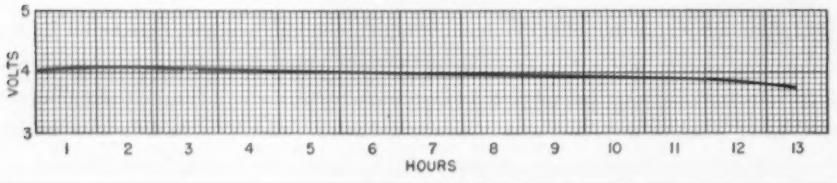
Proof of Wheat Performance



See how the Wheat "Forty-Niner" maintains a high percentage of initial light efficiency right through the end of the shift! The chart clearly shows how the "Forty-Niner" maintains its light output at high levels during and beyond the entire working period. This is graphic proof of Wheat efficiency in battery design and construction.

Check these and other advantages of the Wheat "Forty-Niner" in the Wheat Bulletin. Write for your copy today!

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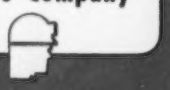

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Anthracite Division, Forty Fort, Pa.
Ashland Division, Ashland, Ky.
Bemeco Division, Beckley, W. Va.
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A MESSAGE TO AMERICAN INDUSTRY • ONE OF A SERIES

Can We Afford a $71.8 Billion Budget?

THE BUDGET submitted to Congress by President Eisenhower for the year beginning July 1 proposes federal spending of $71.8 billion. In only four years, three during World War II and one during the Korean War, has the government spent more. Under the proposed budget the government expects to collect $73.6 billion, mostly through individual and corporation income taxes.†

The principal reason for the size of the budget and for this year's increase is an expanding defense program. About 60% of all budget expenditures in the coming fiscal year will be for national security programs. Moreover, this area accounts for about 90% of the proposed increase in federal spending. In addition, as the chart shows, there are large expenditures proposed for purposes other than defense.

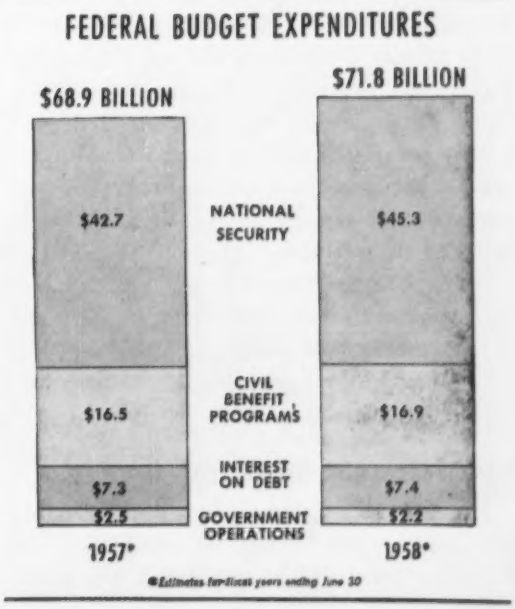
Continued budgets of this size, some contend, will lead to inflation and wreck our economy. It has been suggested that they might lead to "a depression that will curl your hair." Yet many insist that the budget, large as it is, still is inadequate in many respects — for defense, schools, agriculture, small business, health, research, indeed, for almost every activity in which the government has become involved.

Is It Really Too Big?

Actually, the proposed budget would place no greater burden on the economy than any budget in the last six years, because our economy has been growing. Federal spending per capita under the proposed budget will be about $416, or $10 more than this year; but our per capita income rose almost $80 last year. And, because of our increasing population, next year's expenditures will, in fact, amount to *less* per capita than in 1954 when federal spending was $4 billion lower.

Another way of measuring the burden of government expenditures on the economy is to compare the purchases of goods and services of all branches of government — federal, state and local — with the total output of the nation. The share of our national product taken by government this year will be about the same as in the past two years and, furthermore, about the same as the average for the past 28 years.

By the standard of any recent year, the budget is within the means of the American economy. In this sense, we can "afford" it. But the pros-



†*These figures refer to the regular federal budget and do not include operations of trust funds, primarily for social security programs and the new federal aid program for highways, which are financed by special taxes.*

pect of steadily increasing budgets, requiring 20% or more of our national income, introduces another threat.

The Real Threat

Large and rising budgets that do not balance government spending with higher tax collections clearly would be inflationary and would destroy the value of the savings and income of all who lagged in the race with climbing prices. But serious dangers will still exist even if our budget continues to be balanced, as this year's is.

- **Budgets that require a large take in taxes eat up the savings required to finance private industry.** What the taxpayers must give the government they cannot save. This deprives private industry of the savings and resources needed to expand and modernize producing facilities.
- **High tax rates also undermine the incentive to save and invest in normal business enterprises by taking such a large share of any income gained.** Taxes on corporation income now take 52% of all income over $25,000. And taxes on individual incomes can take as much as 90% of earnings that remain after this 52% bite.
- **High taxes encourage, on the part of both individuals and corporations, the search for "gimmicks" and special treatment.** As a leading character in Cameron Hawley's novel *Executive Suite* observed: "To a far greater degree than most people realize, income tax has become a primary governing factor in corporation management." Indeed, it is only because of the numerous gimmicks and special provisions now available that high tax rates have not already inflicted greater damage to economic incentives.

These dangers comprise the real threat of large and rising federal budgets. It is a threat to continued growth of our economy, and it is no less a threat merely because the budget is technically in balance.

What Should Be Done?

In attempting to hold government spending within reasonable bounds, we should *not* hold back on needed civilian programs. The heavy demands now being urged at all levels of government for roads and schools, for instance, are largely the result of failure to keep pace with the growth of the country. Furthermore, we cannot cut provisions for national security below the minimum level of safety. And unhappily, defense in the rocket and missile age is fantastically and ever increasingly expensive.

What we *can* do is enforce some financial discipline on our military leaders, and hold down our defense expenditures by making sure their demands are justified and by requiring efficiency. In the civilian programs, though some need to be increased to serve a growing economy, we can eliminate the outright waste.

A More Difficult Job

We must also do something far more difficult, and that is to reduce federal programs of aid to special groups at the expense of all the taxpayers. The new budget calls for over $5 billion for veterans, and another $5 billion for farmers. A number of industries and areas stand to receive aid in large amounts based less on necessity than on political pressure. These demands for increased aid, year after year, must be resisted if we are to have any hope of stopping a relentless rise in our budget.

Then, as our national income increases, we can look forward to reducing tax rates and providing greater incentives for the private sector of the economy. **Only in this way — by keeping government spending in line with economic growth — can we prevent our federal budget from being a crippling burden.**

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

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WASHINGTON IMPACT

Highlights

OF PURCHASE CUTS AND POLITICS—When the Congressional economy axe finally fell on Government support purchases for domestic metals and minerals late last month, it had a definite "once and for all" ring. But to the ears of those accustomed to the sound and fury of Washington political maneuvers, the ring was muffled by whispered promises of compromise.

What happened was that the Senate, after seven weeks of battling House budget cutters, quit holding out for any part of the $30-million the Interior Department needed to keep alive stop-gap buying of domestic tungsten and three other minerals through the rest of this fiscal year—ending June 30. This was part of the $91-million authorized last year to support domestic mines until the department worked out its long-range mining policy doctrine—$21-million already had been spent, $40-million is still at issue between the House and the Senate in the budget for fiscal 1958—beginning July 1.

On the surface, it looks like the end of the purchase program as a means of giving domestic producers Government aid. Unable to push through the $30-million, Senate chances of insisting on the remaining $40-million—which the House already has cut out—appear slim.

But in yielding "strategically," mining state Senators have won at least two advantages—(1) building a case on the record for the strategic importance of keeping some mines open, and (2) extracting some promises of compromise from the budget-minded legislators in considering either the 1958 appropriations or the long-range support doctrine. There is also a third, subtler point that Senate Interior Committee members who have been pushing Government aid programs have made—that the Government is already committed to "doing something" for domestic producers as a result of Congress authorizing last year's stop-gap purchases for which the funds are now being cut.

Here is how Western state Senators salvaged something from their defeat. The $30-million had been hung up in a joint House-Senate Conference Committee for seven weeks. The House approved no money for domestic tungsten, fluorspar, asbestos and columbium-tantalum purchases, the Senate was finally ready to compromise by cutting the money to $10-million, and requiring it to go only to small producers who don't both mine and use the minerals involved.

The House Appropriations Committee sponsored an unprecedented joint resolution, making some concessions to the Senate conferees' stand on other agency money, but insisting on no money for mining purchases. The Senate rejected this resolution, amended it to include the compromise $10-million for mines, sent it back to the House. House tabled it, introduced another resolution containing only the money it had voted—zero for mining—and sent it back to the Senate just as the Upper Chamber was about to recess for Easter vacation.

Sen. George W. Malone (R-Nev.) took the floor to rehash the entire history of Government support and philosophy toward domestic mining—and, armed with three library carts full of books and speeches—launched a full-scale filibuster.

Malone threatened to hold Congress in session throughout not only the Easter recess, but "until the snow is nine-feet deep on Pennsylvania Avenue."

The Republican leadership tried to call off Malone—at first without success. On the second day, however, Malone folded his papers and quit, allowing the second House money resolution—without any money for minerals purchases—to pass.

Officially, no one will talk about why Malone quit. But observers note two main considerations. The first is that if Malone had persisted, he would have alienated more votes than he would have won. The second is that having voluntarily retreated from a position where he could have at least harrassed the entire Congress, he probably received some concessions. One was that Administration and Democratic leaders alike took the floor to say that something should be done for small mine producers. Also, he may have kept alive the hope that some money will be voted for minerals purchases in the fiscal 1958 budget. But it won't likely be the $40-million originally asked.

Railroads Lose Claim To Mineral Deposits

MINERAL LAND CLAIMS to ore, gas and oil deposits under railroad rights of way do not belong to the railroads, the United States Supreme Court has ruled.

The railroads previously have claimed these rights in conjunction with so-called "aid to construction" land grants to the railroads on either side of their rights of way. These grants were authorized by Congress nearly 100 years ago as incentives to extend their tracks. However, the High Court said, the Secretary of Interior was then required to determine that these land grants contained no minerals, before they were given to the railroads, therefore that Congress did not intend the roads to lay claim to deposits under their rights of way themselves.

Ironically, rich mineral and oil deposits later turned up in these non-mineral lands, and legally belong to the railroads. The Supreme Court decision, however, makes clear that such was not the intention of Congress, and therefore does not extend to deposits under the rights of way.

Fluorspar Miners Gird For Import Quota Fight

FLUORSPAR PRODUCERS are spearheading the drive to win Congressional support for import quotas. Independent fluorspar producers association representatives are holding a series of "educational" breakfasts for various groups of Congressmen to convince them that a general quota bill is the best means of protecting domestic industries from too competitive foreign exports.

The fluorspar people are joining with and rallying other domestic producers interested in quota protection, such as textile, hardwood and plywood, chemical and fish product makers.

The idea of quotas is not new. Faced with a traditional liberal trade policy over the past 25 years, which the Eisenhower Administration supports, protectionists in Congress have been introducing quota bills for some time.

The fluorspar people hope to unite all industries interested in import restrictions behind a joint effort in hopes of log-rolling some quotas through Congress over stiff opposition. The idea is that Senators and Congressmen representing one industry will back quotas for other industries to beef up support for their own.

Rep. Henderson Lanham (D-Ga.), influential spokesman for southern textile groups, has a general quota bill already introduced. Other specific quotas for individual items have been proposed in both the House and Senate. The fluorspar producers are pushing for a general bill similar to Lanham's, but which would

spell out specific quotas for different industries. Such a measure would provide import barriers, running from 15% to 30% of domestic consumption, above which imports would be taxed prohibitively or banned outright.

Fluorspar spokesmen say they would be willing to trade off 75% of the metallurgical grade fluorspar market for 75% of the domestic consumption of acid grade fluorspar.

Quotas are not the only front on which protectionist forces are rising. Anti-free traders have high hopes of defeating proposed U. S. membership in the International Organization for Trade Cooperation (OTC) sponsored by the White House, tighten anti-dumping laws up for revision this year, and attack the whole Reciprocal Trade Agreements program when it comes up for extension at the next session of Congress.

But the quota bill is the focal point for protectionist sentiment for the next several months. Although the concerted drive for quota legislation probably will not be launched before the early part of next year, proponents want to lay the groundwork as soon as possible—through such promotional campaigns as the fluorspar breakfasts.

Late Developments

BARTER OF U. S. CROP SURPLUSES for foreign strategic materials continues to increase, in the face of rising industry opposition. The Senate has agreed to extend the program to Iron Curtain countries, mainly Poland. Congress also agreed to boost money for the program of exchanging crops for foreign currencies which are then used to buy minerals in the country which receives the crops—from $3-billion to $4-billion. The most recent barter acquisition statistics show that the Government supplemental stockpile has been swelled by $40.2-million worth of foreign metals and minerals during the first two months of 1957 as compared to $104.9-million for the full fiscal year 1956.

•

WORLD ALUMINUM OUTPUT is surveyed in a new Commerce Department review of the industry's progress from 1900, available from the Government Printing Office, Washington, D.C. Production in the U. S. has grown from 7,500 short tons a half-century ago to over 3-million in 1954, or 46% of world totals. Consumption is rising in the U. S. by 11.6% per year, the report indicates.

•

DO-IT-YOURSELF KIT for selenium detection has been announced by the Interior Department, Bureau of Mines. Developed by Bureau technicians at Salt Lake City, the kit uses chemicals and camp stove or blowtorch in a simple method of testing selenium deposits.

Labor This Month

MINE-MILL—A LESSON FOR LABOR: Behind all the sound and fury that surrounds exposures of union racketeering, there's one lingering threat to the labor movement. Union leaders are convinced their organizations will survive after all the dirt shows up before the public. A housecleaning—enough to satisfy even the most stringent taskmaster—is already going on in the merged AFL-CIO. But, what concerns these officials in the long run is the future path of the International Brotherhood of Teamsters who are facing Congressional and union charges of corruption. What happens if the trucking union, the AFL-CIO's largest affiliate, is either forced out or leaves the federation? Their concern is the object lesson provided by the Mine, Mill and Smelter Workers union.

EXPULSION—A DOUBLE-EDGED SWORD: When the CIO kicked out Mine-Mill on charges of Communist-domination in 1949, it was assumed that the non-ferrous union would begin to disintegrate. Eight years later—in 1957—this viewpoint was shown once and for all to be both optimistic and inaccurate. MMSW, at its recent convention, proved to be just about as strong as ever. While it claims some 100,000 members, it actually represents closer to 70,000 but this is not far from the total the mine union bargained for at the time of its CIO membership. And, in those eight years it has survived continual raiding by rival unions.

In a rundown of the scorecard over the past year, Mine-Mill's leadership could note a number of successes, not the least of which was its 1956 collective bargaining contract—estimated to add $1,500 to every member's paycheck over the three-year period of the agreement. This, plus claims of effective political and legislative strength, shows Mine-Mill a still strong union despite its years of independence. This point is not lost on the AFL-CIO leadership which is currently embroiled in a punishment program against the Teamsters union. If the showdown comes, and it appears almost inevitable, the only way out is expulsion of the trucking union. But, with Mine-Mill as the prime example, the federation leaders hope above all to avoid such a drastic step.

LABOR MAVERICKS HOLD TIGHT: After the demise of those small unions expelled from the CIO, the record of survival has held fast. Led by Mine-Mill but including the International Longshoremen's Association as example number two, the signs are clear on what would happen to an independent teamsters union. Certainly, it could survive in the field of labor, but more important, it could probably dish out more trouble for rival unions than it would have to take. Where Mine-Mill and the longshore union—expelled from the old AFL in 1953—operate in single industries, the teamsters cut across almost all union lines. And, as truck drivers, they virtually control those lines. If the other two unions can survive deliberate efforts to disband them by the rest of labor, the Teamsters can do much more. That's why there'll be some slow, cautious steps in hopes of avoiding the final punishment.

DEFENSE IN DENVER: Finally acceding to long-standing requests of Mine-Mill attorneys, the Government agreed to shift the site of the union's Subversive Board trial from Washington, D. C. to Denver. After months of hearings, the Subversive Activities Control Board is still just getting into its hearings on Justice Department charges that the mine union is Communist-infiltrated. The Government's aim is a positive finding of this charge that would bar Mine-Mill from representing non-ferrous employees. The official reason from Mine-Mill's request to shift the case to Denver is to be near the union records so they can be used in the trial. But, too, it's clear that the mine union would welcome what is considered a more favorable climate in its headquarters area.

While the Subversive Board continues with Mine-Mill, the union also faces a second Government onslaught that shows signs of a long legal run. The case of the 14 Mine-Mill officers, indicted on charges of conspiracy to file false Taft-Hartley non-Communist affidavits, still is before the union.

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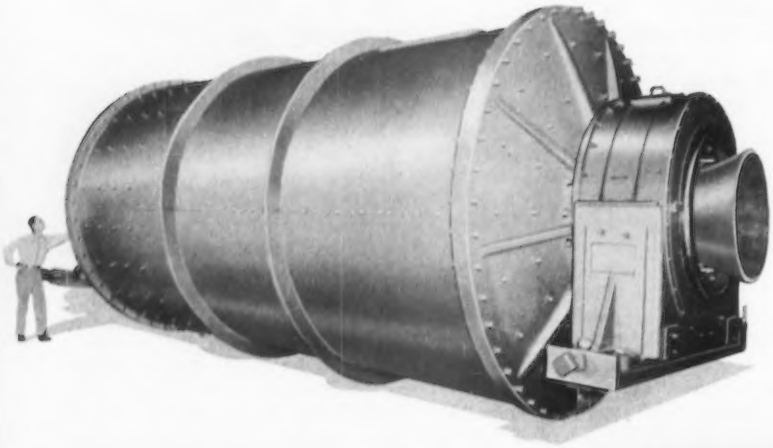

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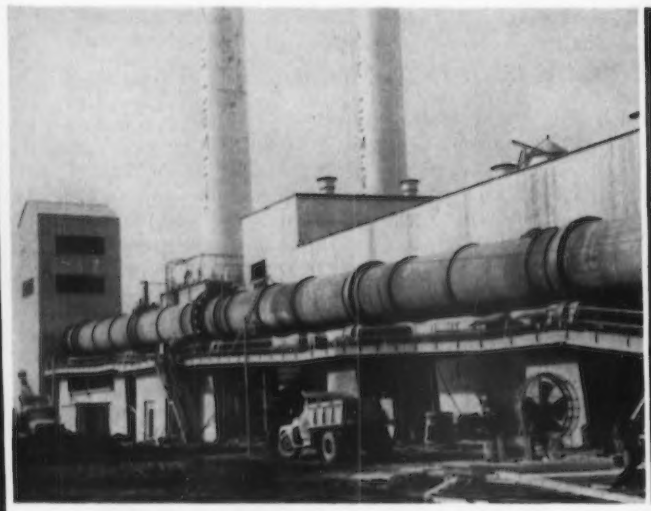

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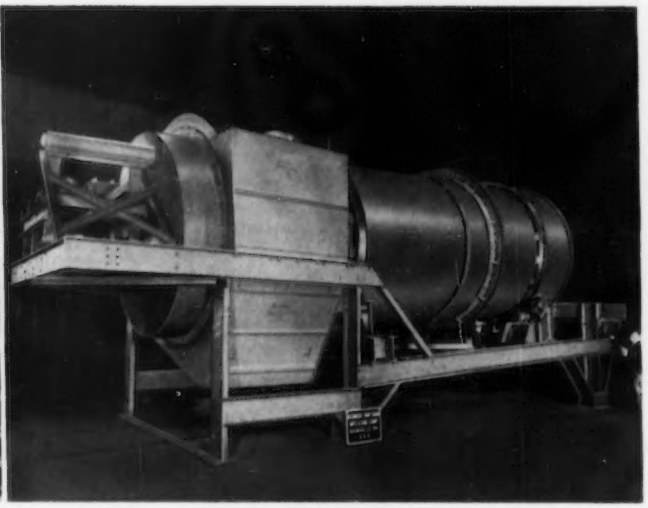

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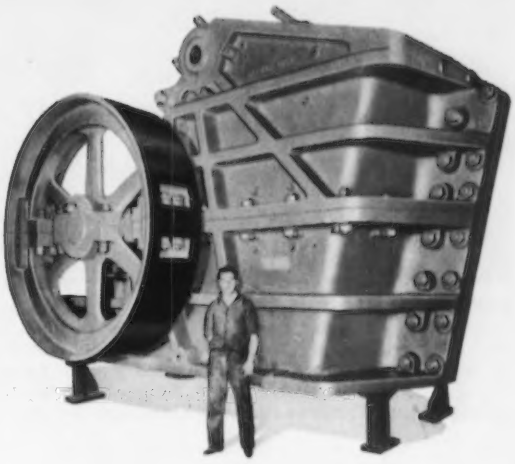

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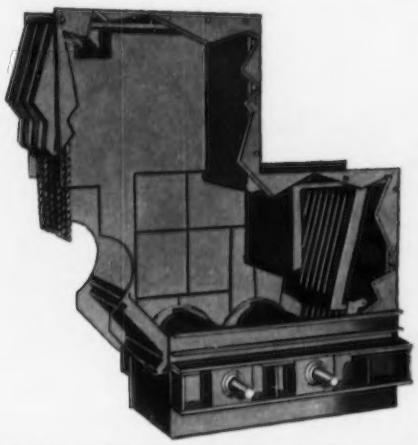

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THIS MONTH IN MINING *(Continued)*

PARTICIPANTS in a panel discussion on mining techniques and problems at the Moab meeting of AIME's uranium section included (left to right) Virgil Bilyeu, mine superintendent for Utex Exploration Co.; Donald T. Delicate, mine superintendent at Moab for Homestake Mining Co.; and William Love, mine manager for Hecla Mining Co. at Wallace, Idaho. James Borden, UCC Nuclear; A. C. Hilander, Idarado Mining Co.; Ken Nobs of Hidden Spendor, and Max Pierson, Utex, also participated.

Industry-AEC Future Outlined at Moab AIME

This article begins on p 72

ming and the Spokane, Wash., district in favor of solving problems by expansion of projected mills.

8. Jones proposed to the industry acceptance of certain "standard terms" in up-grading discussions, such as:

a. Upgrading—raising sub-marginal ore to ore grade.
b. Concentrator—Physical concentration of a normal grade ore.
c. Chemical concentrator—Chemical concentration of submarginal or normal grade ore to produce low-grade concentrates.

He warned that in the case of "b and c", i.e. physical concentration of normal ores and chemical up-grading, "modification of the Commision's procurement contracts (for the mills receiving this feed material) would appear to be necessary. . . "and, in fact, the AEC already has placed this "rule" into operation.

9. Co-mingling of up-graded ores from normal ores whether from certified properties or not could result in disqualification of payment of the production bonus under Circular 6, he warned.

"The applicability of the initial production bonus to chemical up-graded products will call for a review on an individual case basis," he announced.

What Jones is saying, in effect, is that the AEC is not at this time greatly interested in a wide extension of the benefits of either existing (ore) or future (concentrates purchase) programs to up-graded materials.

This grows out of change in AEC goal from production of ore in a period of military emergency to sustaining the domestic raw materials end of the uranium industry until the civilian demand can catch up with rolling output of 3,250,000 tons of mine ore annually.

For those companies which wish to embark on the purchase of such ores, there is in prospect a renegotiation downward of their existing concentrates sales contracts.

This stems from fact that most such contracts recently and now being signed place upward and lower limits on grade of mill feed material. Higher the grade goes, the less the price and vice versa —within the prescribed limits.

Others participating in mining and milling discussions included: Charles A. Steen, president and chief geologist, Utex Exploration Corp., Moab, who spoke at opening noon luncheon of his experiences since discoveries at Mi Vida mine in Big Indian district, and Howard Balsley, Moab, a verteran uranium miner of the area.

Mr. Balsley, who has been "in the uranium business since 1908" recounted developments in mining of uranium-vanadium and radium ores on the Colorado Plateau since 1898.

Other speakers were: Edwin T. Wood, Moab, manager of Far West Mine of Hidden Splendor Mining Co., who reviewed trackless mining; C. K. McArthur, Grand Junction, Colo., head of National Lead Co's pilot plant at the AEC center. He discussed uranium recovery in lignitic ores.

Participating in panels on mining and milling in the uranium industry were: Donald T. Delicate, Utah manager of mines for Homestake Mining Co., Moab; William Love, Wallace, Ida., manager of mines, Hecla Mining Co.; Virgil Bilyeu, mine superintendent for Utex; James Borden, Uravan, Colo., mine superintendent for Union Carbide Nuclear; R. L. Schultz, assistant general superintendent for Hidden Splendor; H. C. Hilander, general superintendent for Idarado Mining Co., Telluride, Colo.; Max Pierson, senior geologist for Utex.

D. F. McElhatten, chairman of the Utah Section, AIME, and Roger V. Pierce, vice president of the institute, both of Salt Lake City, conferred full section status on the uranium group as representatives of Grover J. Holt, AIME president and general manager of Minnesota and Michigan mines of Cleveland Cliffs.

Foote Announces Lithium Sales Contract With AEC

OFFICIAL CONFIRMATION of a sales contract signed between Foote Mineral Co. and the U. S. Atomic Energy Commission has been announced by Gordon Chambers, president of the Philadelphia lithium producer. Quantity of material involved is still classified, but Chambers told stockholders that his firm sells "virgin" lithium hydroxide to the AEC, as do two other major lithium producers.

According to Chambers, the AEC removes the lithium-6 isotope and again makes the "depleted" material available to the original producers in the proportion in which it was supplied. Chemically, the material is identical with virgin material. It is re-sold to industrial consumers by the respective companies through normal trade channels.

Ship Reactor Ordered

A $9.8-MILLION CONTRACT for design, development and fabrication of a nuclear reactor and components of the propulsion plant for the first nuclear-powered merchant ship has been awarded the engineering firm of Babcock and Wilcox. The ship is being built as a joint project of AEC and the Maritime Administration of the Department of Commerce.

Manganese in Antarctic

A SMALL VEIN of manganese silicate identified by Dr. Brian H. Mason, curator of geology and mineralogy at the American Museum of Natural History as tephroite, has been found on Clark Peninsula, Wilkes Land, Antarctica.

Specimens were obtained by Walter Sullivan of the *New York Times*, on a visit in connection with the International Geophysical Year. Sullivan reports the samples came from "a vein of dark, metallic-looking rock on a ridge."

ANOTHER CATERPILLAR FIRST!

CERTIFIED POWER

FOR CAT* DIESEL ENGINES

CATERPILLAR TRACTOR CO.

ENGINE POWER CERTIFICATION

This is to certify that the Diesel Engine herein described has been engineered, manufactured and tested in accordance with rigid Caterpillar Standards. The materials and workmanship incorporated into this engine give it the inherent capacity for satisfactory performance when applied in accordance with the power ratings established and recommended by this company. The MAXIMUM OUTPUT capacity of this standard production engine is 200 H.P. @ 2000 R.P.M. equipped with: air cleaner, water pump, lubricating oil pump, fuel pump, and standard intake and exhaust manifolds.

I certify that R. L. Henson, Supervisor of Diesel Engine Test, Caterpillar Tractor Co., [illegible] Certification and I affix my [illegible] 19 57

B. L. Henson
Supervisor Diesel Engine Test
Caterpillar Tractor Co.
Peoria, Illinois

[illegible] /58

Caterpillar Model D326 Industrial was manufactured and shipped as follows: Engine Serial No. 39B1018 Shipping Date February 11, 1957

Power Setting 152 H.P. @ 1600 R.P.M. Intermittent Power Rating

Radiator & Fan
Ether Starting Aid
32V Charging Generator
Governor Control
Tachometer Drive
Muffler
Heater Connections
Remote Shut-off

POWER RATINGS

MAXIMUM OUTPUT is the horsepower capacity of the engine; a measure of the maximum power, ± 5%, that can be developed for five minutes without drop in speed.

INTERMITTENT HORSEPOWER is a rating for use in variable load applications such as excavators, hoists, and standby power units, where the duration of sustained full power output is one hour or less, with the average output not over 80% of Intermittent Horsepower.

RATED HORSEPOWER is a rating for use in applications such as planing mills, hammer mills, and rock crushers where the duration of sustained full power output is 12 hours or less.

CONTINUOUS HORSEPOWER is a rating for use in applications such as work-boats and pumps where the duration of sustained full power output is 24 hours per day, day in—day out.

Horsepower figures are established in accordance with rigid Caterpillar standards. All ratings, corrected to sea level barometric pressure (29.92 in. Hg.) and standard temperature (60°F), apply to a production engine including air cleaner, water pump, lubricating oil pump, fuel pump and standard intake and exhaust manifolds. The above ratings are based on British and American BHP.

Printed in U.S.A.

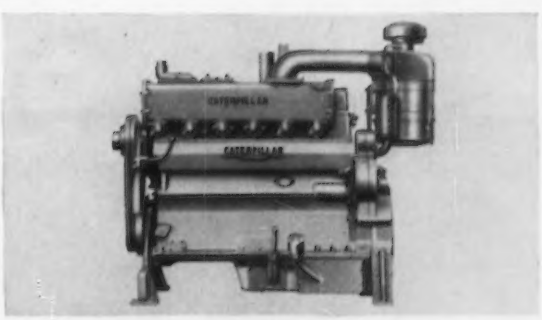
FORM NO. 515-22553

In a quarter century of diesel leadership Caterpillar Engines have achieved a reputation for *honestly rated power*. Owners have found that they can depend on a Cat Diesel to deliver the power promised.

Now, to back this reputation, Caterpillar becomes the *first* manufacturer to issue a certificate showing the horsepower capabilities of the engine. This certificate is signed by Caterpillar Tractor Co. and certified by a notary public.

You have a right to demand *certified power* when you invest in an engine. You get it when you buy from your Caterpillar Dealer. Let him show you the certified power plant that fits your needs.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.



CATERPILLAR*

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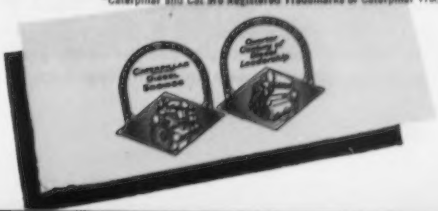


THIS MONTH IN MINING *(Continued)*

Surveying The Annual Reports

Newmont Mining Corp. net income in 1956 was $17,084,919 and $9,410,000 was expended in new enterprises. Most of these funds were used to help Southern Peru Copper Corp., Newmont Oil Co., Dawn Mining Co., Granduc Mines Ltd., and for the purchase of common stock in Atlas Cons. Mining & Development Co. Annual report broke down company holdings and progress as follows:

Cassiar Asbestos Corp. (17.1% Newmont) had net profit $2,225,088 from increased production of 356,334 tons of crude ore. Aerial tramway was completed between mine and mill. Further expansion planned and a long-range stripping program undertaken.

Empire Star Mines Co., Ltd. (37.3% Newmont) milled 20,850 tons gold ore from Grass Valley property before the operation was suspended. Mine is being allowed to fill with water. Small gold mine at Browns Valley is being opened under three year lease. Empire had net loss of $256,517 for the year.

New Verde Mines Co., wholly owned subsidiary of Empire Star, also reported a net loss in 1956, from development of uranium orebody in Colorado. Development of this prospect will continue.

Idarado Mining Co. (74.2% Newmont) treated 481,700 tons ore, averaging 0.067 oz gold, 1.66 oz Ag, 1.71% Pb and 0.64% Cu and 2.79% Zn. Net income was $1,072,115. Older of two mills was shut down and all mine output now goes to rehabilitated Pandora mill.

Magma Copper Co. (21.5% Newmont) showed net income of $7,475,827. Magma mine produced 47,934,948 lb copper. San Manuel Copper Corp., owned by Magma, started smelter in 1956 and produced 78,152,140 lb copper by year end.

Societe Nord Africaine du Plomb and Societe Algerienne du Zinc, (both 31.8% Newmont) produced 190,962 metric tons, 14.07% Zn and 1.98% Pb. Reserves at du Zinc are sufficient for thre more years operation.

O'Okiep Copper Co. Ltd. (56.3% Newmont) produced 32,327 short tons of blister copper and realized a net income of $15,334,558. During the year, the last of the tungsten ore reserves were shipped (419 tons concentrate).

Resurrection Mining Co. (100% Newmont) is developing Leadville district in joint venture with AS&R. Ore from both properties will go to Resurrection mill. Total production rate will be about 12,000 tpm at full capacity.

Sheritt Gordon Mines Ltd. (38.3% Newmont) mined and milled 750,000 tons at Lynn Lake and produced 19,200,000 lb of nickel at Fort Saskatchewan. Reserves at the Lake were 13,070,000 tons, 1.108% Ni and 0.58% Cu. Farley shaft is down to 650 ft. Sherritt spent $2,700,000 to expand the Fort and showed a net profit of about $4.5-million for the year.

Tsumeb Corp. Ltd. (28.5% Newmont) showed a net profit of $22,300,926 from 139,452 tons metals recovered. Germanium was sold to the amount of 3,700 kg.

Dawn Mining Co. (51% Newmont) started mill construction to treat all of Dawn's uranium ore. Mill capacity will be such as to treat all of Dawn's ore reserves by 1962.

Granduc Mines Ltd. (33.3% Newmont) has shaft down to 363 ft by year end. Shaft will go to 1200 ft for exploration of the orebody.

Palabora Mining Co., Ltd. (South Africa) has been organized by Rio Tinto and Transvaal Ore Co. Ltd. Option has been taken on prospecting and mineral rights and Newmont has the right to purchase up to 30% of the stock.

Southern Peru Copper Corp. (10.25% Newmont) has begun stripping work on Toquepala and construction of mill, smelter and townsite. Over 4,000 men are employed by the contractors and the company. Total output of 120,000 tons blister is planned per year.

Newmont continued exploration with following results: Belgian Congo and Iran work was unsuccessful and abandoned; diamond drilling in Balya district of Turkey continued in search for lead-zinc deposits; nothing attractive has come of three concessions in Ethiopia; and large scale laterite nickel project pilot run in Santa Rosalia, Baja, California in joint effort with Hanna Coal & Ore Corp. will get experimental smelting started by early 1957.

Construction of a new geophysical and metallurgical laboratory at Danbury, Conn. was completed.

American Smelting & Refining Co. (Asarco) operated most mines and smelters at full capacity during the year with the result that $39,826,820 net profit was realized. Asarco spend $21,280,000 in capital expansion, most of this on Black Lake asbestos property and Southern Peru Copper. Asarco's total investment in Southern Peru Copper Corp. now stands at $23,476,000

Garfield Chemical & Mfg. Corp. joint effort with Kennecott Copper Corp. produced 296,312 tons of sulphuric acid. Garfield now has 384,000-ton capacity.

At Perth Amboy, N. J., there is under construction a 50% increase in continuous cast copper alloy facilities. And a selenium plant was installed at Baltimore, Md.

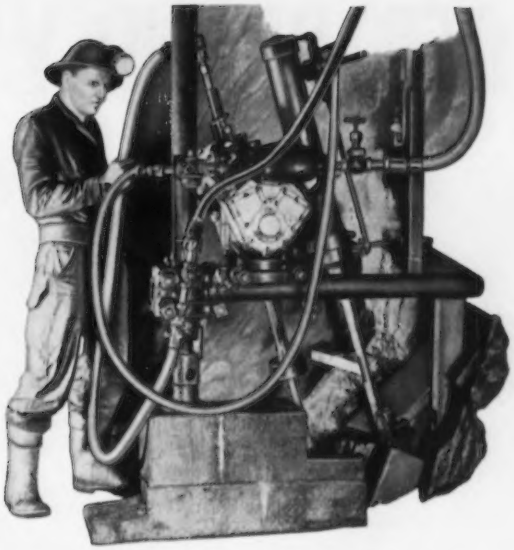
Federated Metals division announced plans for a 72-million lb secondary aluminum alloy smelter at Alton, Ill.

Buchans, Newfoundland is making preparations for 14-ft circular shaft to go to 3,400 to 4,000 ft. Black Lake Asbestos has dredged out half of the overburden that must be removed before mining can start. Mill construction has started. During year some $7,979,000 was spent on project. Half of the estimated $32-million expenditure on this project has been made.

Mount Isa Mines Ltd. (52% Asarco) net profit was £A4,301,931 from production of 40,930 tons lead bullion containing 3.289,645 oz Ag, 34,366 tons zinc concentrate and 27,337 tons blister copper, during fiscal year ending June 30, 1956. Five-year expansion plan will triple ore production by 1961 (1.5-million tons in 1956). At Townsville, Queensland, a Mt. Isa subsidiary is constructing a 33,000 tpy copper refinery.

Southern Peru Copper Corp. (57.75% Asarco) has spent $32,500,000 in past year. *(Continued on p 132)*

LIBERIAN IRON ORE from the Bomi Hills, running 68% Fe, is loaded aboard Republic Steel Co. vessels as it comes out of the ground. Liberian surveys reportedly indicate more than 1-billion tons in the Republic.



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CONVEYOR BELTING . . . provides longer service life because of its resistance to abrasion, shock and abuse.

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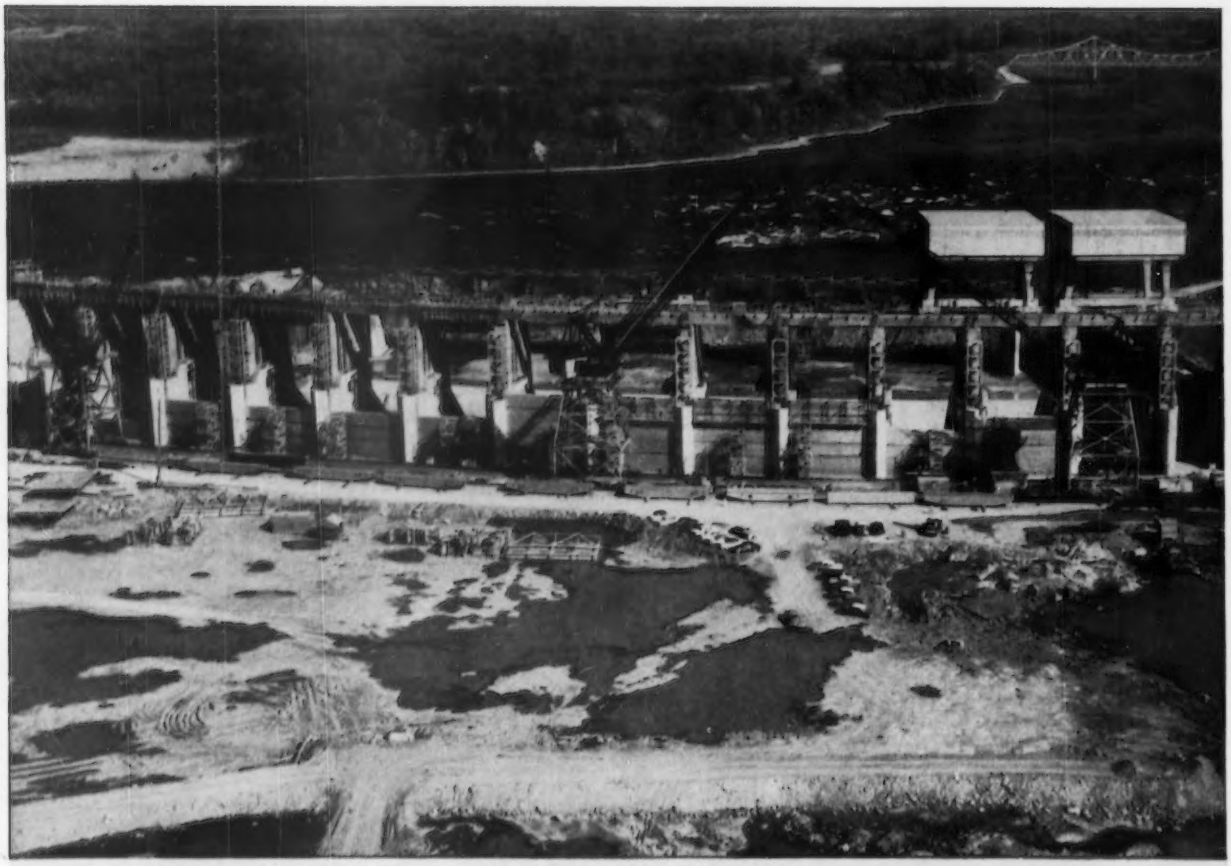
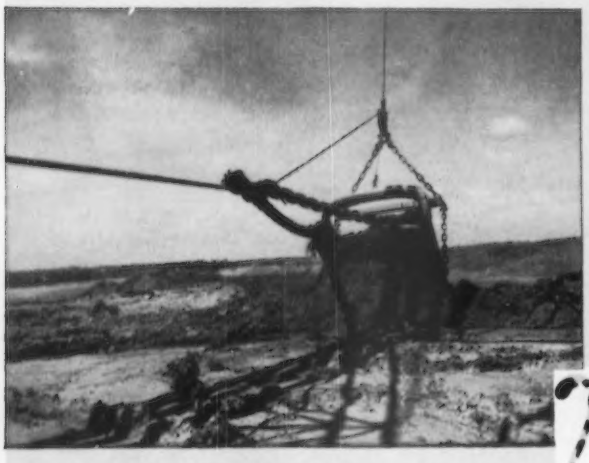
TIGER BRAND WIRE ROPE



Building the Long Sault Dam. When completed, this dam will contain approximately 653,000 cu. yds. of concrete. The three large gantry cranes used in pouring this concrete are rigged with Tiger Brand Wire Ropes.



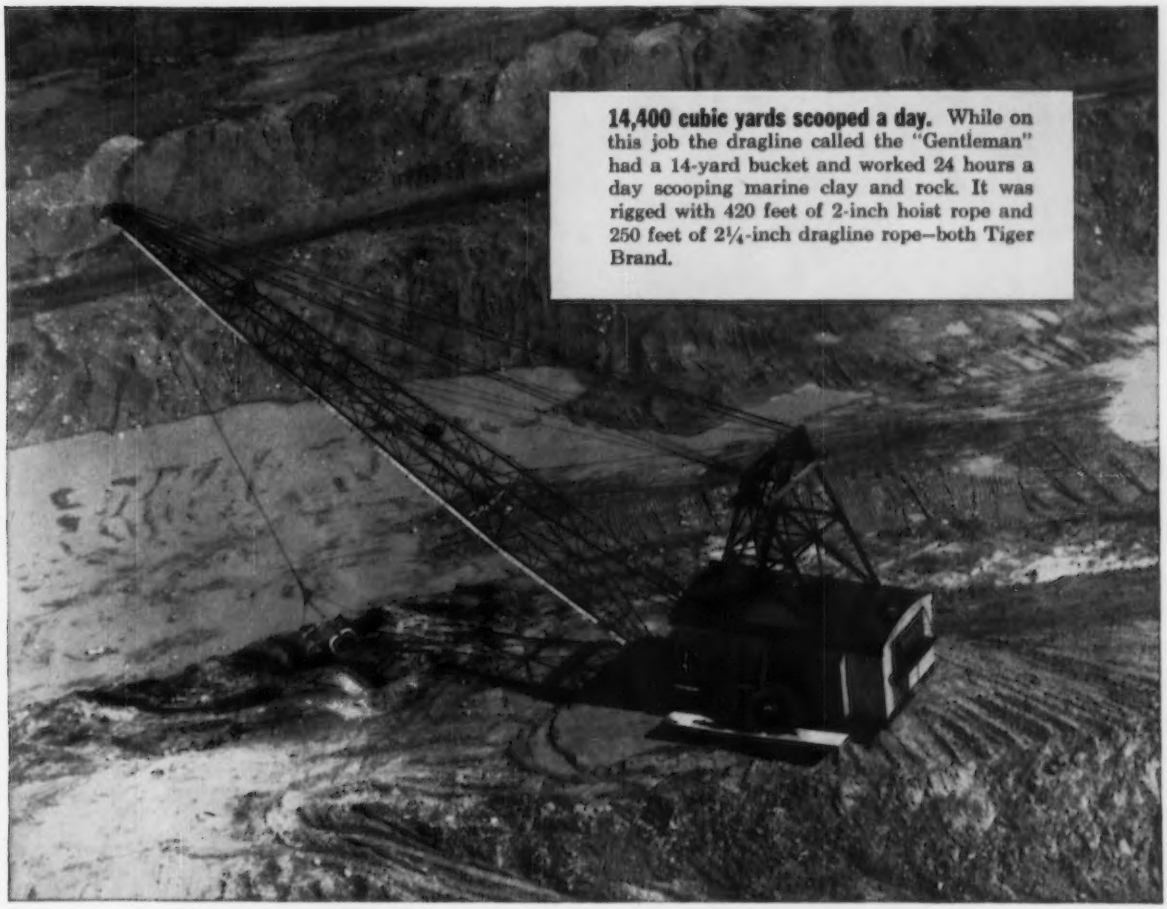
Sticky marine clay weighs almost twice as much as regular overburden, puts greater strain on wire rope and equipment.

Shovel rope takes a beating and Tiger Brand is made to withstand rough service and heavy abrasion.

at work on St. Lawrence Seaway and Power Projects

THE FABULOUS ST. LAWRENCE SEAWAY and St. Lawrence Power Projects are the largest construction undertakings of all time, costing over $900 million for the Seaway and power development. To keep the big machines working at top speed requires all kinds of wire rope—and most of it is USS American Tiger Brand.

Speed was such an important factor on this job that all equipment and supplies were selected with trouble-free performance in mind. American Steel & Wire set up a wire rope warehouse nearby for quick deliveries of any type of wire rope needed. Here are a few illustrations of the many jobs being performed by Tiger Brand Wire Rope.



14,400 cubic yards scooped a day. While on this job the dragline called the "Gentleman" had a 14-yard bucket and worked 24 hours a day scooping marine clay and rock. It was rigged with 420 feet of 2-inch hoist rope and 250 feet of 2¼-inch dragline rope—both Tiger Brand.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
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USS AMERICAN TIGER BRAND WIRE ROPE

USS

Excellay Preformed

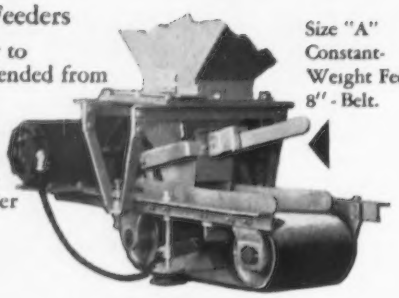
UNITED STATES STEEL

LOW INSTALLED COST

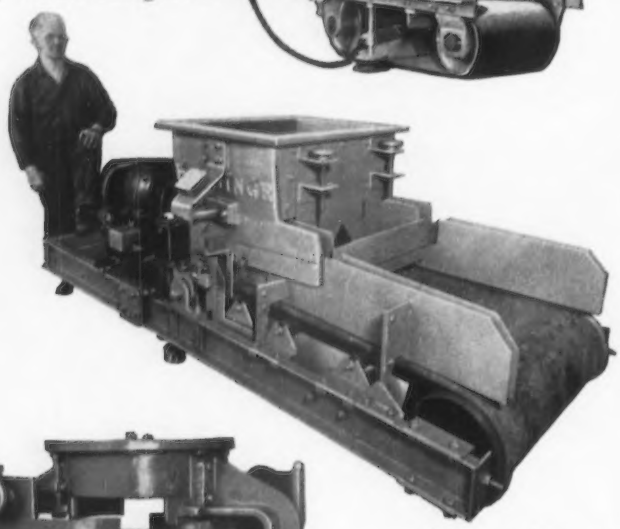
All **HARDINGE** Feeders

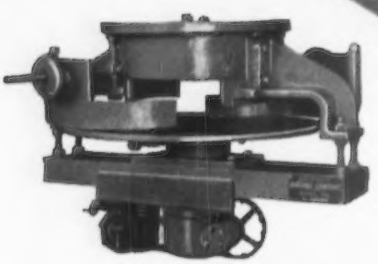
from 100 POUNDS/hour to 100 TONS/hour are suspended from the feed bin which:

- Eliminates costly feeder support structure
- Provides accessibility to equipment following feeder



Size "A" Constant-Weight Feeder, 8" - Belt.

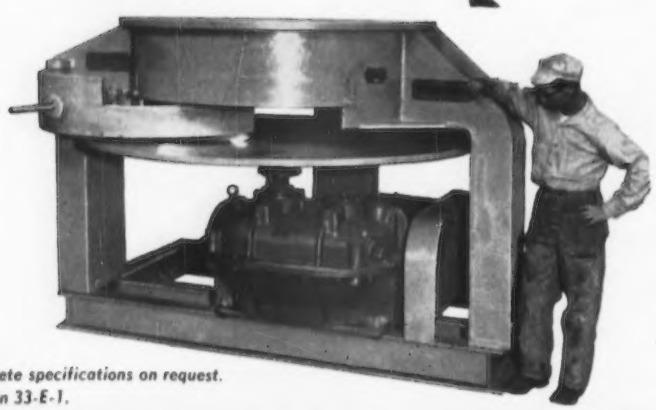




Size "D" Constant-Weight Feeder, 36" - Belt.

30" Disc Feeder

84" Disc Feeder



Complete specifications on request.
Bulletin 33-E-1.

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Annual Reports *(Continued)*

Asarco installed a germanium recovery department at El Paso and began construction of a new mineral and smelting lab at El Paso. At Baltimore, a pilot plant has been developing a more economic method of continuous casting of phosphor-copper billets.

Texas Gulf Sulphur reports that a lead-zinc-iron orebody has been outlined in Bathurst, New Brunswick area—several million tons. Net profit for year was $28,135,880 with bulk of the sulphur coming from Newgulf, Moss Bluff and Spindletop plants in Texas. Company also produced sulphur from sour gas at Worland, Wyo. and continued to receive its share of the sulphur from Long Point, Tex. plant. During the year the Frasch plant at Fannett Dome, Tex. was under construction to be onstream at 2-million gpd hot water by 1958.

Cia. Exploradora del Istmo S. A. started steaming at 1-million gal water per day at Isthmus of Tehuantepec, Mexico. Total cost of Texas Gulf's Mexico expenditures to date is $10-million.

Exploration drilling was conducted as follows: off shore near Galveston, Tex. (sulphur) and acquired another lease from the state of Texas; Bathurst, N. B. (sulphides); Copper Cliff, Ont., (sulphur dioxide) signed agreement with Inco to pilot an elemental sulphur from gas plant; Sicily—continued to explore (sulphur) and acquire options; Italy—began preliminary exploration (sulphur); Alaska—diamond drilling sulphide orebody; Ethiopia conducting survey in 1957.

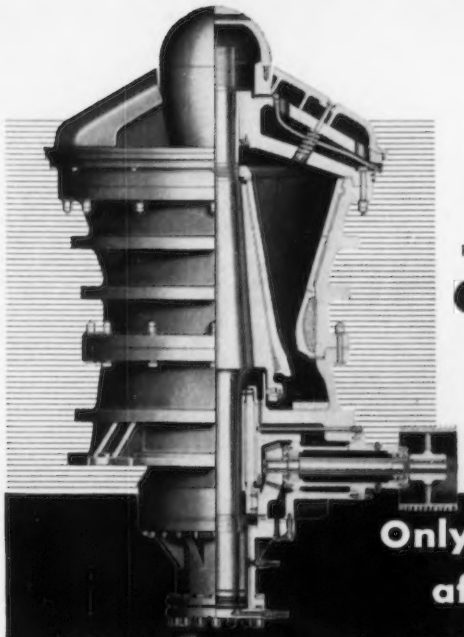
Michigan Chemical Corp. had net income of $411,402, reported that new bromine plant at El Dorado started operating in February and that rare earth division "has become an important factor in the industry."

Howe Sound Co. and subsidiaries ended 1956 with net profit of $2,319,890 from the production of—copper (33,426,647 lb), lead (30,643,350 lb), zinc (46,169,130 lb), cobalt (2,435,976 lb), nickel (98,496), gold (96,149 oz), silver (1,223,366 oz) and pyrite (50,270 tons).

Company decided to work toward closing down both Snow Lake, Manitoba gold mine for lack of ore and Chelan Division, Holden, Wash., due to rising costs, and has begun an intensified exploration program to extend life of El Carmen, Batopilas, Mexico. Cobalt production at Garfield, Utah was a company record, with refinery virtually at capacity. Electrolytic plant, to cost $750,000, is under construction at Garfield. All cobalt production is currently earmarked for U. S. stockpile under a contract calling for 6.5-million lb delivery. So far some 500,000 lb has been delivered.

Blackbird mine, Cobalt, Idaho improved ore reserves during the year, as did Britannia mine, Britannia Beach, B. C. and El Potosi, Chihuahua, Mexico.

Inspiration Consolidated Copper Co. produced 74,166,920 lb and delivered 70,380,477 lb copper in 1956 for a net income of $8,527,549. Capital expenditures in 1956 were $6,553,950. All ore production came from the Live Oak and



Superior

Primary and Secondary

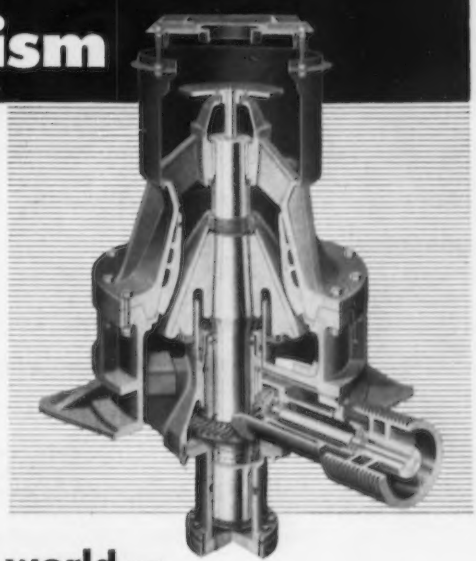
Crusher

Bulletin O7B7870

- *Retains initial setting* by compensating for wear on crushing surfaces with one-man, one-minute *Hydroset* mechanism.
- *Entire circuit remains in balance.* Feed size to subsequent equipment remains uniform.
- *Aid in starting* is provided after crusher stops under load. *Hydroset* control reduces torque requirements. Clearing of the crushing chamber is facilitated.
- *High capacity* is the result of a unique crushing chamber design and *Hydroset* control of mainshaft position.

Only Allis-Chalmers gyratory crushers afford the many advantages of

Hydroset Mechanism



Hydrocone

Secondary and Tertiary

Crusher

Bulletin O7B7145C

- *Wide range of settings* at the flip of a switch is made possible by the *Hydroset* mechanism.
- *Chamber is cleared* — if crusher stops under load — by merely lowering the mainshaft hydraulically with the *Hydroset* mechanism.
- *Protection against tramp iron* is provided by *Hydroset* mechanism and Automatic Reset. After tramp iron is released, crusher returns to original setting. Safe — no spring-loaded chamber.
- *Compensation for wear,* as in the primary crusher, is a one-man, one-minute operation with *Hydroset* control.

Proved all over the world—

Limestone in China, iron ore in Africa, lead zinc in South America—gravel, dolomite, cement clinker, copper, perlite, trap rock — name the product, name the location, you'll find the *Hydroset* mechanism on the job proving its tremendous profit advantage. Hundreds of Allis-Chalmers gyratory crushers, processing the widest range of products, are equipped with *Hydroset* mechanism. Even the world's largest crusher, crushing hard taconite, features the convenience and economy of this remarkable design feature.

See your Allis-Chalmers representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

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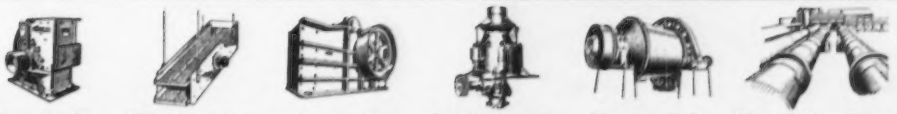
ALLIS-CHALMERS



Hammermills | Vibrating Screens | Jaw Crushers | Gyratory Crushers | Grinding Mills | Kilns, Coolers, Dryers

A-5322

NORDBERG MACHINERY ... used by leading TACONITE producers

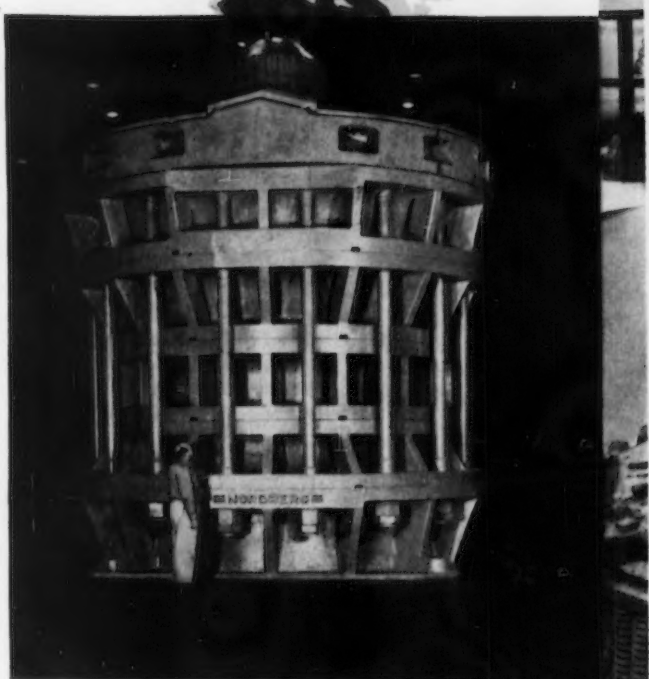
To provide adequate iron ore reserves for today's increased steel production, the large-scale beneficiation of Taconite ore has become imperative.

Long used in the economical production of Taconite concentrates in the Arctic region of Norway, Nordberg Machinery is now serving the huge Taconite operations in northern Minnesota . . . where a new era in U.S. iron ore production is now underway.

The selection of Nordberg Machinery for the processing of the extremely hard Taconite ore again follows the trend of the mining fraternity to rely on this heavy duty machinery for its proven ability to reduce ores and minerals at low per ton cost.

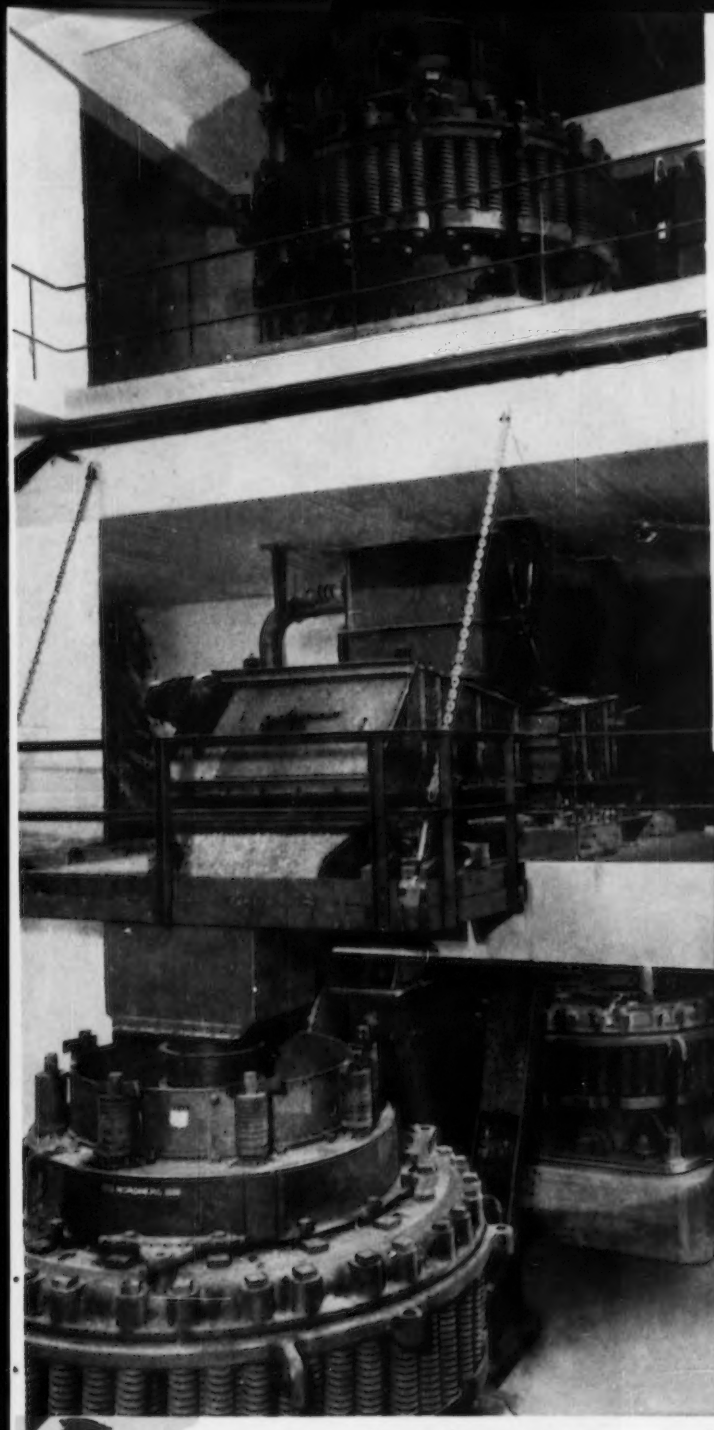
Nordberg Machinery now in use by leading Taconite producers includes Symons® Primary Gyratory Crushers, Symons Cone Crushers, Nordberg Rod and Ball Mills, and Symons Rod Deck Screens.

While *your* crushing and processing problems may not involve Taconite, you may be sure that Nordberg machinery is the logical choice for practically any other ore and mineral processing operation where big tonnages at low cost are required.

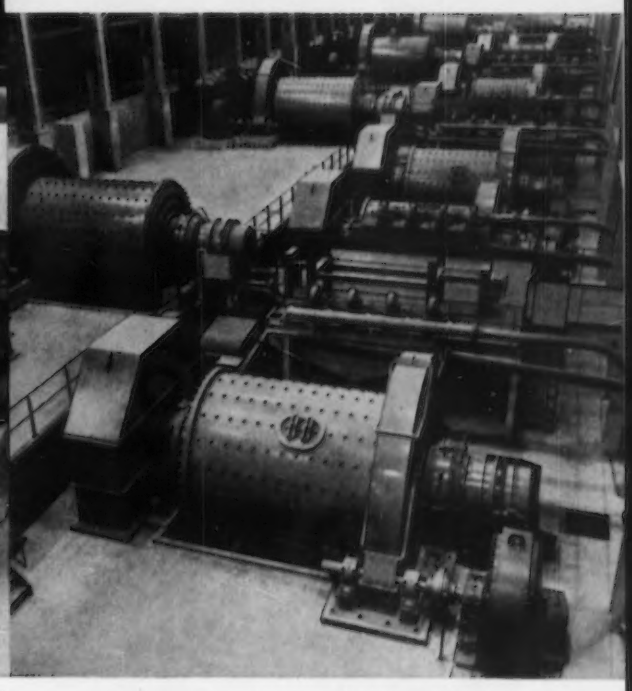


This Symons Primary Gyratory Crusher has a feed opening of 54" and capacity of 2000 or more tons per hour of hard, abrasive Taconite ore. Symons Gyratories are built in sizes up to 72" feed openings, with capacities of over 3500 tons per hour.

NORDBERG MFG. CO., MILWAUKEE,



Typical arrangement of Symons Cone Crushers and Symons Vibrating Rod Deck Screens installed for secondary and tertiary crushing, and screening of Taconite ore. Cone Crushers of this type are built in sizes up to 7′ diameter, with capacities to over 900 tons per hour.



Battery of four Nordberg 10½′ x 16′ Rod Mills and eight Nordberg 10½′ x 14′ Ball Mills installed in a large Taconite concentrating plant. Other Nordberg Grinding Mills are built in sizes from 6′ to 13′ diameter and up to 50′ in length in Rod, Ball, Pebble, Tube and Compartment types.

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KNOWN THROUGHOUT THE WORLD

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TORONTO • MEXICO, D. F. • LONDON • GENEVA • JOHANNESBURG

Before you buy any giant-sized
Measure TD-24 giant-sized

With full-time "live" power on both tracks, the TD-24 almost builds the road itself—hugging the mountain slope, giving added *operating ease, safety, and capacity!* That's another bonus from exclusive time-proven Planet-Power steering.

When you're 'dozing through rock and other materials, instant fingertip Hi-Lo shifting is a big cycle-speeder. And it cuts operator effort way down!

Try holding a 19-ton load on the blade with any other crawler this big—making a turn as this TD-24 is doing with both tracks pulling, while stockpiling coal with a special wing-type blade. The TD-24's operator can make "round-house," feathered, or pivot turns—with fingertip ease!

tractor advantages!

When you buy a big crawler look beyond sheer size and weight. You may be paying for enough extra "iron" to cause a startling jump in fuel and upkeep costs. So compare. Weigh bigness against provable working and earning capacity! Measure these giant-sized TD-24 advantages that have proven out over 8 years of on-the-job success!

Eliminates "dead-track drag!"

Does the giant you're considering steer with full-time "live" power and "live" traction on both tracks? TD-24 users by the thousands have proved that any crawler *this big* is obsolete without exclusive, time-proved Planet-Power steering advantages!

Planet-Power steering eliminates power-wasting, load-limiting "dead-track drag." Upgrade, downgrade, or on the level, you can smoothly turn a heavily-loaded TD-24—under positive control!

Does the big one you're looking at give cycle-speeding on-the-go shifting? The TD-24 does! And the exclusive two-speed planetary system teamed with a 4 speed synchromesh transmission —gives instant, stall-preventing and time-gaining Hi-Lo shifting, *without declutching.*

Does that big one you need have the genuine in-seat, seconds-fast, all-weather International gasoline conversion starting? Or the operating ease, power-transfer efficiency, and service-simplicity of the International Cerametallic-faced engine clutch? Or 8 practical speeds *forward and reverse?* Only the TD-24 has all these, plus dozens of other giant-sized advantages!

Prove to yourself the TD-24 beats all other giant-sized power—for *performance value*—for *big-scale ability to make you big money.* Ask your International Construction Equipment Distributor for a demonstration of a Gear-Drive or Torque-Converter TD-24!

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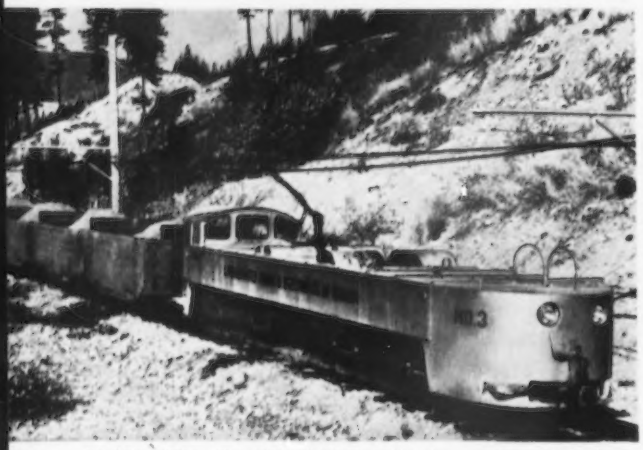
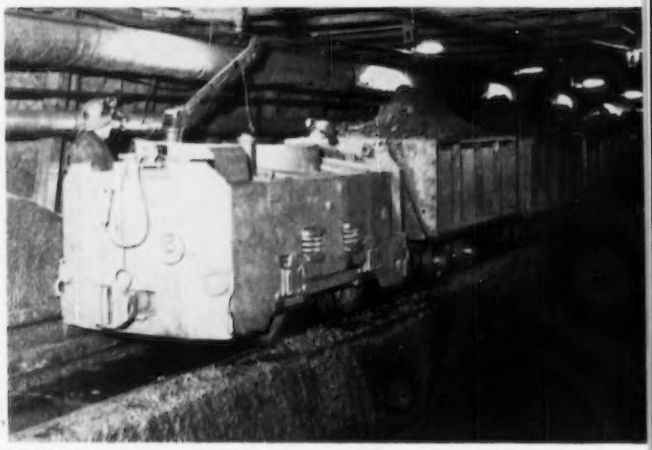
A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Side-Boom Tractors ... Self-Propelled Scrapers and Bottom-Dumps ... Crawler and Rubber-Tired Loaders ... Off-Highway Trucks ... Diesel and Carbureted Engines ... Motor Trucks

Heap-loading the sideboarded International *"75"* Payscraper in less than a minute proves the economy and efficiency of the TD-24 as a "pusher."

34,000 TONS OF MOLYBDENUM ORE are hauled each day from Climax Molybdenum Company's mine at Climax, Colorado. Seven of these 20-ton General Electric swivel truck locomotives help maintain this record haulage.



11,000 TONS OF ORE DAILY with three 40-ton G-E locomotives in operation at The Consolidated Mining & Smelting Co. of Canada Ltd.'s Kimberly, B.C. lead zinc mine.



PLANNING FOR INCREASED PAY LOADS resulted in the purchase of six 8-ton G-E locomotives by Jones & Laughlin Steel Corp. for their Negaunee, Mich. Tracy Mine.

3 Mines Boost Haulage Output with Efficient, Dependable General Electric Locomotives

Whatever your mine haulage or gathering operations may be, there's a General Electric mine locomotive that's right for the job. In an increasing number of mines, as in the case of the three pictured above, G-E locomotives are proving that haulage output and efficiency can be significantly increased with the correct motive power applied to a particular haulage need. For more information, or for a free survey of your haulage needs at no obligation to you, contact your General Electric Apparatus Sales Office. General Electric Company, Locomotive and Car Equipment Dept., Erie, Pa. 120-95

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Annual Reports (*Continued*)

Thornton Pits with underground activities limited to ore transportation and transfer of leaching-in-place solutions. Reserves were estimated at year end to be approximately 953-million lb recoverable copper (not including leaching-in-place ore).

In addition, 10-million tons of 2% copper has been blocked out in the Christmas mine. Total reserves in Christmas will not be known for some time. A 2,500-tpd concentrator is planned and shaft sinking is in progress.

Inspiration has spent $6,170,696 ($5,903,816 in 1956) in the conversion of Inspiration concentrator to the dual process that will leach the oxide copper and float the sulphide. Dual plant, while not yet complete, was placed onstream in January 1957. Company is now equipped to mine and mill mixed oxide-sulphide ore with maximum recovery and minimum cost and a greater annual production.

Magma Copper Co.'s earnings in 1956 were $7,475,827, with a small amount of this total attributable to San Manuel operation. Production was 126,087,088 lb, of which 47 934,948 came from Magma mine and 78,152,140 from San Manuel. San Manuel is expected to reach full production by mid-1957 (70,000 tons annually). As by-products from the copper production, Magma yielded 11,702 oz gold and 493,299 oz silver, while San Manuel produced 591,970 lb molybdenum sulphide, 9,719 oz gold and 136,074 oz silver.

All Magma copper was sold currently as produced. All San Manuel copper produced and available for sale likewise was sold currently. Total copper sales in 1956 were 100,997,089 lb.

Magma expended $81,542 at Magma during the year and $4,370,238 at San Manuel. Total capital expenditures at San Manuel Copper Corp. now stand at $102,589,445.

At Magma mine, a total of 453,683 tons, 5.45% Cu were mined and milled and new reserves were discovered in Far East area and the Main Vein. At San Manuel 5.5-million tons, 0.77% Cu were mined and milled. A molybdenum concentrator was placed in operation in April 1956.

Electrolytic Zinc Co. of Australia Ltd. had a net income of £A2,832,949 from 103,964 tons zinc produced and 75,428 tons zinc sold for Australian use. In addition, the company produced 71,168 tons sulphuric acid and 85,113 tons superphosphate.

At their West Coast department, total ore reserves were 2.3-million tons.

Risdon Works completed an ammonium sulphate plant.

Company is exploring new areas with Rio Tinto in northwest Tasmania; and with Mt. Lyell Mining & Railway Co. in southwest Tasmania.

Risdon produced 228 tons cadmium and 19 tons cobaltic oxide in addition to the usual zinc and copper residues.

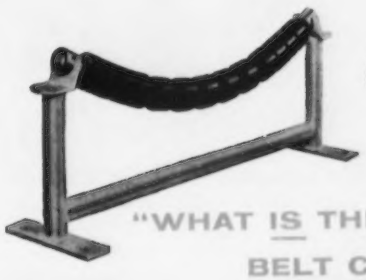
North Broken Hill Ltd. annual report for the year ending June 30, 1956, shows that the company earned a net profit of £A2,025,297. Ore mined was 380,065 tons, with 86.4% coming from the North Section and the rest from British-Junction. The mill treated 377,775 tons and produced 66,736 tons lead concentrate, 69,987 tons zinc concentrate. Lead recovery was 96.9%. Zinc recovery was 86.8% and silver recovery was 91.9%.

Ore reserves stood at 4,883,000 tons.

American Metal Co.'s net earnings in 1956 were set at $23,859,000 from its mining and smelting operations and holdings in other companies. For 1957, American Metals has earmarked $20-million for expansion and exploration. Sales of metals were—copper, 490,000 tons; lead, 281,000 tons; zinc 165,000 tons; tin, 20,000 tons; silver 37,555,000 oz; and gold 899,000 oz.

United States Metals Refining Co. refined 12% of U. S. total copper—186,500 tons. Compania Metalurgica Penoles produced 80,000 tons lead in 1956—37% of Mexico's output. Blackwell Zinc Co., Inc. produced 82,000 tons zinc—8% of U. S. slab output. Precious metals refineries at Carteret, N. J. and Monterrey, Mexico produced 30-million oz Ag and 640,000 oz Au.

New cadmium recovery and refining



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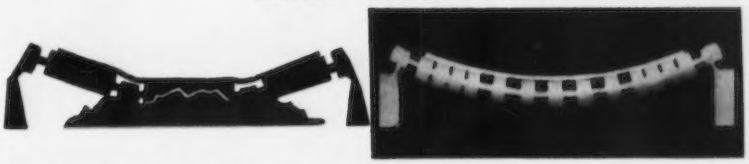
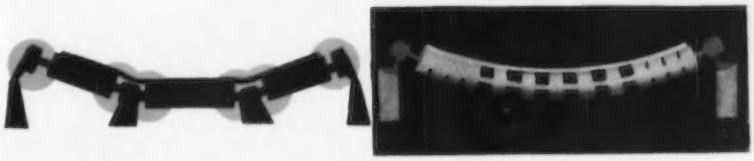
"WHAT IS THE JOY LIMBEROLLER BELT CONVEYOR IDLER?"



Radically different from all other idlers, the Limberoller is a flexible steel cable suspended between two bearings . . . neoprene discs are molded to the cable . . . forming a single roll idler which turns on its own axis. This imparts a flexing action which is self-cleaning . . . prevents material buildup, a source of trouble with conventional idlers.

Supports the belt throughout its entire width . . . doesn't have the unsupported gaps left between the rolls like conventional idlers. Increases belt life 20% and more. Materials don't "bump along" from idler to idler, either.



Two bearings, instead of six. They are up out of the dirt zone, not hiding down under the belt. Joy has never replaced a single bearing due to normal failure. Heard enough? There's more . . . get the whole story from ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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Pioneer Sand and Gravel Co., Seattle, Wash., needs a huge flow of material to supply its ready-mix plants and barges. They're getting it with a 12-cu. yd. Crescent Scraper.

The Crescent handles 480 yds. or 720 tons per hr. over an average haul from 300 to 350 ft. It operates along a 675-ft. span between movable head and tail towers located at the base and top of the 240-ft. high bank.

In addition to high rate of delivery, adoption of the Sauerman Method provides two other advantages over the 5-cu. yd. power shovel that formerly operated off the "toe" of the bank. These are: (1) material can now be taken from anywhere on the bank for blending and selection of gravel, and (2) material can be moved down the slope with no danger of cave-ins.

The tower excavator at Pioneer is mounted on portable towers and engineered by Sauerman for economical excavation in this type of deposit. This same digging tool . . . the Crescent scraper . . . can be engineered to your operation to give you equivalent high production at low cost.

Sauerman Scrapers range from ⅛ cu. yds. up to 18 cu. yds.

Because in most cases it is cheaper to drag material than it is to lift and transport it, *they give you the lowest cost per cu. yd. handled.*

Contact us for information and specific recommendations. Ask for field reports and Catalog A.

This view gives some conception of the height and steepness of the bank on which the Crescent works.

The Crescent delivers to a portable field hopper from which belt conveyors transport the material to the plant.

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Annual Reports *(Continued)*

plant was completed at Blackwell, Okla. early in 1957.

Compania Minera de Penoles, S. A. (98.6% American Metals) operated satisfactorily during the year.

Heath Steele Mines Ltd. completed copper and lead-zinc-copper mill at Newcastle, N. B. Heath Steele (75% American Metals) will have 1500-tpd ore capacity by mid-1957.

Southwest Potash Corp. went onstream in 1956.

Dividends received by American Metals from holdings in other companies totalled $22,592,000 in 1956.

Mufulira Copper Mines Ltd. (32% American Metals) has net profit of $26,011,420 from sale of 103,694 tons copper for year ending June 30, 1956. Total copper production was 108,671 tons. Average production cost at Mufulira rose from 16⅝c to 19½c per lb copper in all forms.

Chibuluma Mines Ltd. (32% American Metals) reached production on their copper-cobalt property in October 1955. Results for six months ending Dec. 31, 1956 were—$804,390 net profit; 2,603 tons copper sales; and 4,655 tons copper produced.

Roan Antelope Copper Mines Ltd. (32.6% American Metals) had net profit of $23,403,836 for the year ending June 30, 1956 from sale of 96,133 tons copper. Production was 99,360 tons. Roan's new subsidiary is constructing an electrolytic refinery at Ndola with 62,000-ton annual output. Total cost of the installation will be approximately $12-million. Roan's production costs for copper in all forms rose from 17 3/4c to 20 7/8c per lb.

Tsumeb Corp. Ltd. (28.5% American Metals) had net income of $22,300,926, based on the following sales—copper, 25,767 tons; lead, 90,206 tons; zinc 4,177 tons; cadmium 122,935 lb; and silver, 1,404,812 oz. Germanium production was expanded two-and-a-half times during 1956.

Bikita Minerals (Pvt) Ltd. (21.5% American Metals) continues to ship concentrate, especially to American Lithium Chemicals, Inc., San Antonio, Texas. American Lithium is 49.9% Bikita-owned.

San Francisco Mines of Mexico, Ltd. (37.5% American Metals) paid American Metals $653,000 in dividends in 1956.

American Metals also holds interest in the following companies: Copper Range Co. (8.72%); and Climax Molybdenum Co. (7.43%).

Polaris Mining Co. showed net profit of $334,491 for 1956. Polaris operates the Silver Summit mine, obtaining production from Silver Summit and New Purim areas in which Polaris has approximately a 56% share. Sunshine Mining Co. operates the Omega and Rotbart areas, in which Polaris holds 50% and 33⅓% respectively.

St. Joseph Lead Co. had total sales of metals at $119,909,612 a net profit of $10,291,357 and capital expenditures of

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Annual Reports *(Continued)*

$3,527,931 in 1956. Approximately 43% of gross earnings came from sales of zinc and 53% from lead sales.

Approximately two-thirds of capital expenditure was made at Josephtown zinc smelter to increase production to 12,000 tpm. Present indications are that capital expenditures in 1957 will be about $14.6-million.

St. Joseph mines in southwest Missouri operated without interruption during the year, producing 100,707 tons lead content. Zinc recovered was 3,152 tons. Indian Creek reached full production rate—2,000 tpd. Pig lead production at Herculaneum smelter amounted to 98,380 tons and slab zinc production totalled 2,856 tons.

Edwards-Balmat area mines operated throughout the year. Zinc concentrates shipped to Josephtown totalled 107,653 tons. Lead concentrates shipped to Herculaneum totalled 2,791 tons.

Josephtown smelter produced 134,023 tons (zinc content of oxide and metal).

Exploration was conducted in Missouri (with a promising new lead prospect being discovered); Portuguese East Africa; Canada; Argentina; Columbia; and Peru (copper-lead-zinc deposit).

Iron ore deposit will be opened in Missouri with approximately 2-million ton per year output. In Peru, Compania Minerales Santander, Inc. has been formed to develop the copper-lead-zinc orebody. Mine will be in production by 1958.

Compania Minera Aguilar, S. A. produced 30,334 tons lead concentrate and 42,366 tons zinc concentrate. Net income was 59,040,989 pesos.

Brunswick Mining & Smelting Corp. Ltd. expended $1,711,000. St. Joseph has advanced some $3.5-million to Brunswick to-date.

Net income of Mine La Motte Corp. (50% St. Joseph Lead Co.) amounted to $155,695 in 1956.

A mining concession has been granted in Columbia and a new company, Cia. Minera San Jose has been formed to develop the deposit. St. Joseph Lead Co. holds 88% interest.

Hecla Mining Co. reported a net income of $904,997 as against $495,956 for 1955. This marked improvement in net income is largely due to operating income of $660,952 from U&I uranium project in the Big Indian district, Moab, Utah. During 1956, U&I property shipped 53,605 tons, 0.438% U_3O_8. Reserves are set at 300,000 tons, 0.75% U_3O_8. In the Hot Rock group of claims, reserves to date are 31,210 tons, 0.4% U_3O_8.

Hecla owns 55% interest in Polaris Mining Co. and 19% interest in Bunker Hill Co. (see elsewhere in this report).

Kerr McGee Oil Industries, Inc. reported that Kermac Nuclear Fuels Corp., in which Kerr McGee holds a majority interest, is still negotiating for a uranium mill in Ambrosia Lakes area. Kerr McGee reserves in Ambrosia Lakes are set at 14-million tons mineable and another 9-million tons probable.

Farm Chemical Resources Development Corp. in which Kerr McGee holds 25% interest, let a contract for shaft sinking at their Carlsbad, N. M. potash deposit. Shaft will be completed by year end, 1957.

Kennecott Copper Corp. reported earnings of $143.1-million after taxes in 1956. Mining divisions reported the following data: (in tons)

	Ore mined	Copper produced
Chino	7,945,386	69,629
Nevada	4,316,148	31,274
Ray	5,852,742	53,248
Utah	32,321,100	248,158
Braden	10,767,314	179,896
Total		582,205

Chino mines division increased ore reserves through diamond drilling and spent $2,250,000 for additional mining equipment. Ore grade was 17.4 lb per ton.

Nevada mines division reserves are relatively smaller than the other U. S. properties. In addition, irregular nature of the orebody complicates mining methods and leads to a slightly higher cost.

Ray mines division completed 12% increase in recovery facilities (leaching, precipitation, flotation, sponge iron and sulphuric acid). These units will be in operation shortly. Progress is being made on $40-million expansion program to raise Ray output by 20,000 tpy. Plans

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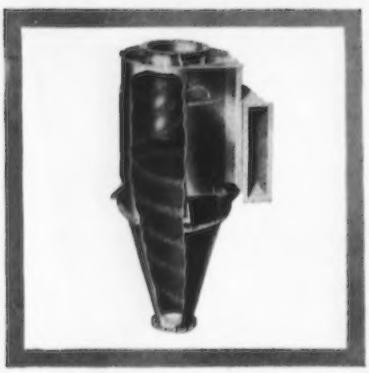

Buell Cyclones offer two "extra-efficiency" advantages: (1) exclusive Shave-off which harnesses double-eddy and puts it to work, and (2), large diameter design which eliminates clogging.

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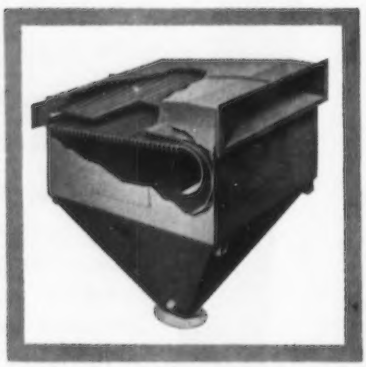

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Annual Reports *(Continued)*

include moving certain surface plants, enlarging the mill and building a smelter.

Utah division is building another tunnel from the pit. Tunnel will be 18,000 ft long and cost $12.9-million. Vertical casting unit, installed in 1955, was in commercial service.

Braden Copper Co., Chile, developed underground water reclamation and hydropower saving installations that resulted in a 15% increase in the amount of copper produced. Concentrator is being modernized and is about 40% complete. Work has started on new contact sulphuric acid plant.

Kennecott continued exploration for copper and other valuable minerals as follows: acquired a moderate sized copper orebody at Glacier Peak, Wash.; acquired a 620-sq mile mineral concession with Hudson Bay Mining & Smelting in Coronation Gulf area, N. W. T; continued to drill in New Brunswick after discovering small copper deposit and other base metal showings; signed an agreement with Greek government to develop asbestos deposit, if drilling proves this to be desirable; and formed Quebec Columbium Ltd. (with Molybdenum Corp. of America) to investigate Oka, Que. columbium-tantalum.

Research in 1956 covered a wide variety of subjects and metals. Kennecott now has a process to recover rhenium from molybdenum concentrates. Company is developing a method to recover pyrite from copper tailings so that it can be used for sponge iron production at Ray. In addition, Kennecott is working on methods to beneficiate Oka and Nigerian columbium-tantalum ores and to recover the thorium, zirconium and hafnium that occur in these materials.

Research work is underway on an electrolytic zirconium process. Arrangements have been made with Horizons Titanium Corp. for cooperation. Pilot plant will be constructed.

Virginia Orange Free State Gold Mining Co., Ltd. increased capacity in cyanide mill to 108,000 tons a month and will complete further expansion to 125,000 tpm by mid-1958. Virginia milled 1,016,000 tons to recover 236,739 oz gold and 596,725 lb of uranium concentrate. Working profit from gold was £518,894. Working profit from uranium was £1,272,477 and that from sulphuric acid—£288,092.

Merriespruit Gold Mining Co. Ltd. suffered a flooding in November that brought the mine to a standstill. Decision on operation of this mine awaits engineering report.

Tin & Associated Minerals Ltd. (52% Kennecott) operated at a loss in 1956 due to end of U. S. stockpiling program and the drop in columbium concentrate price from $4 to $1.25 a lb.

Chase Brass & Copper Co. Inc. started operating new, small-tube mill at Cleveland.

Quebec Iron & Titanium Corp. improved operating methods, completed a pre-concentrating plant at Sorel, Que. QIT produced 195,156 tons titanium slag and 142,745 tons of high-grade pig

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35 tons payload ...
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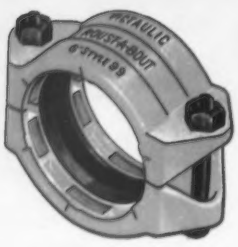
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".



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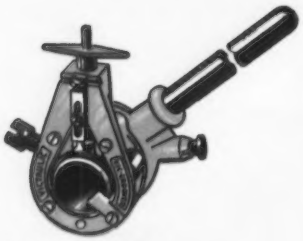
Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".



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PLUS FITTINGS AND GROOVING TOOLS

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VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

Annual Reports *(Continued)*

iron. Five furnaces are in operation and construction has started on three more. In addition, it has been found that concentrator tailings are a good substitute for fluorspar for open-hearth fluxing. Mill trials on this ingredient are underway.

Allied-Kennecott Titanium Corp. announced a $40-million titanium plant to be onstream by late 1958.

Normetal Mining Corp., Ltd. milled 382,860 tons copper ore for a net profit of $2,511,000 in 1956.

Torbrit Silver Mines Ltd. milled 134,652 tons and had a net profit of $177,900 in 1956.

Quemont Mining Corp., Ltd. reported 840,942 tons milled for an estimated net profit of $3,674,000 in 1956.

Galkeno Mines Ltd. (formerly Mackeno) resumed milling in July 1956 and showed a net profit for the three months ending September 1956 of $66,909. Ore reserves are 61,399, 36.1 oz Ag, 8% Pb and 8% Zn.

Reynolds Metals Co. annual report shows net sales in 1956 of $405,206,005 and a net income of $41,239,902. Capital expenditures for all programs during the year were $71,715,014. Reynolds estimates 1957 capital expenditures at $120-million.

Reynolds's six reduction plants produced 426,907 tons (1,679,247—U. S. total) of primary aluminum. Total reduction capacity at year end was 488,500 tons (1,775 500—U. S. total).

Of the plus $71-million expanded during the year $5-million was spent on the new 112,500 annual-ton reduction works at Listerhill, Ala. In order to supply alumina to this plant, capacity of the alumina plant at Corpus Christi, Tex., is being increased to 547,500 annual tons. Listerhill plant will be onstream by year end.

Reynolds announced a new 100,000 annual ton primary smelter for upstate New York. Thirty-three year power agreement has been signed with the state and a contract has been negotiated with General Motors for delivery of molten aluminum to the GM foundry scheduled for construction next door to the smelter. Total cost of this installation and plus planned additions to their alumina facilities and sheet production will be $150-million.

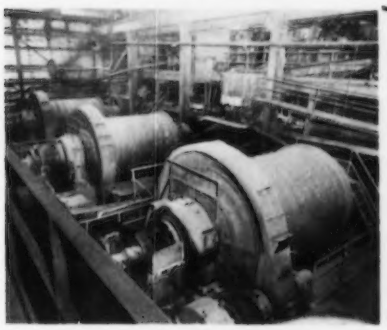
Bauxite ore reserves in Arkansas, Jamaica, British Guiana and Haiti were increased. Haiti operation began shipments in March. By mid-1957, Reynolds will be delivering bauxite at approximately 3-million ton per year rate (company consumed 2-million tons in 1956).

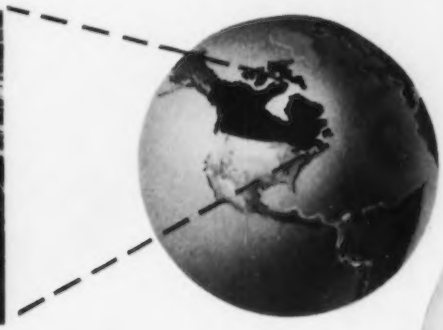
Fluorspar mill, to produce acid grade spar, is under construction at Eagle Pass, Tex. Mill will treat Mexican ore.

Foote Mineral Co. had 1956 sales of $19,245 029 and net profit of $2,243,358. In March 1956, Electro Manganese Corp., Knoxville, Tenn., became a part of the Foote holdings. Electro Manganese is undergoing a 50% expan-

I saw them in Canada, too!

YES, WHEREVER THERE'S MINING, you'll find the successful companies using *Marcy Mills*. The fact that these companies throughout the world continue *reordering* Marcys is evidence of Marcy's low-cost-per-ton production and dependable mechanical operation.





The Quemont Mining Corporation, Noranda, Quebec, has a 9' x 12' Marcy Rod Mill and five 9' x 12' Marcy Ball Mills in its copper-zinc-gold mill. These mills were sold, manufactured and serviced by Mine & Smelter's licensed manufacturer and sales representative, Canadian Vickers, Ltd., Montreal. The Quemont mills are just six of more than 150 Marcys in Canada.

One Reason... *proper design and the best worldwide manufacturing facilities.*

For more than 40 years Mine & Smelter has specialized in the design and manufacture of grinding mills. This *experience* has resulted in a selection of materials and a type of construction which assure long, trouble-free operating service, minimum maintenance, and maximum convenience in installing, aligning, and operating the mill.

It is equally important to you to have available good manufacturing and service facilities, as provided by our U.S. plant . . . and our foreign manufacturers and representatives, who are experienced mining people backed by excellent shop facilities. You can depend on them to do a good job.

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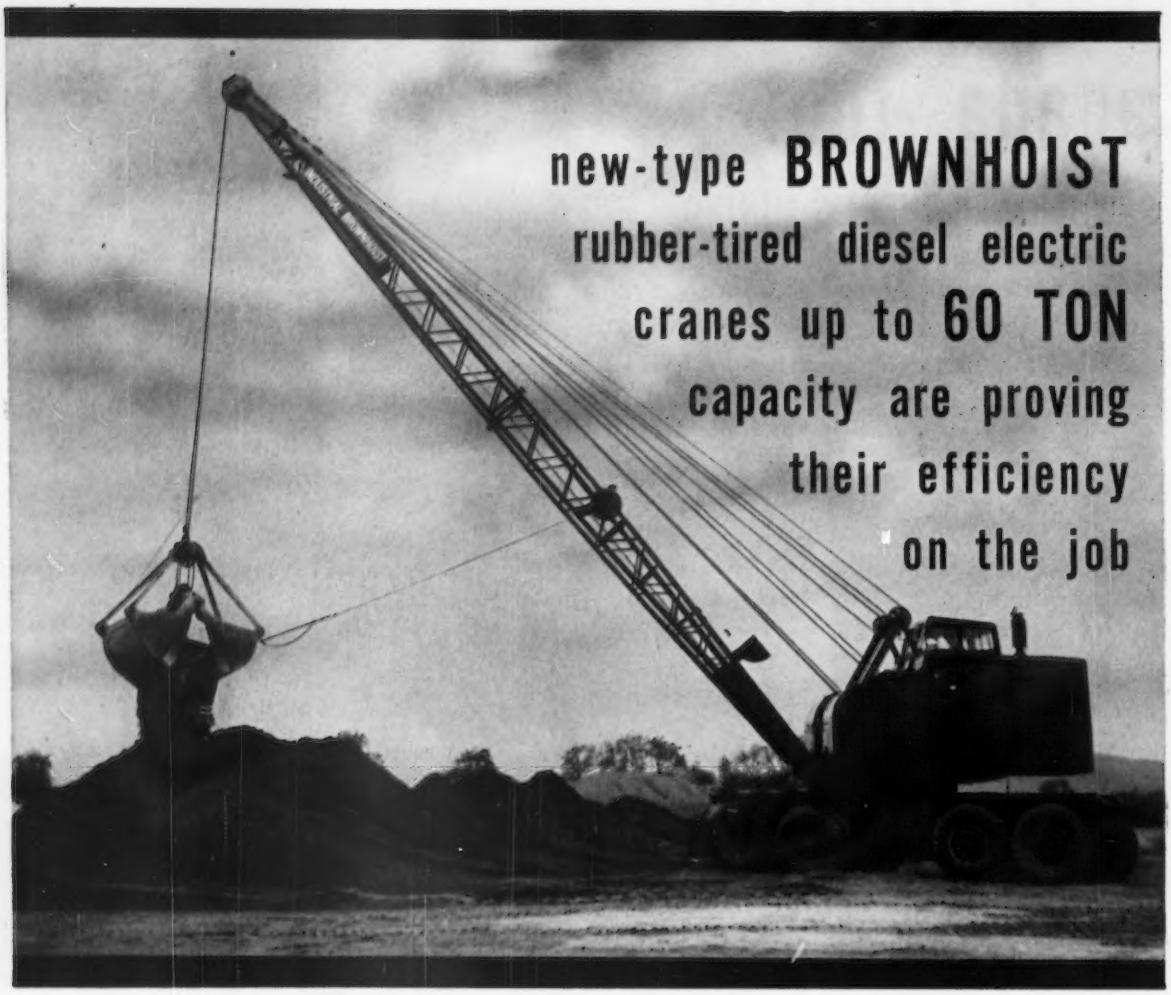

183

BROWNHOIST MATERIAL HANDLING EQUIPMENT GIVES A LIFT TO AMERICAN INDUSTRY

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BAY CITY, MICHIGAN • DISTRICT OFFICES: New York, Philadelphia, Cleveland, Chicago, Denver, San Francisco, Montreal • AGENCIES: Detroit, Birmingham, Houston

The new Brownhoist Wagon-Cranes are specifically designed to do an outstanding job wherever high mobility and high capacity are required. You'll see them at work performing heavy duty jobs in mines, quarries, steel mills, for railroad and lumber operations and for many other large industries. Equipped with dynamatic clutch, anti-friction bearings at all essential points, power steering, electric travel and electric rotation. Mounted on a 12 wheel crane carrier capable of speeds up to 8 miles per hour, the unit can be operated by one man from easy-to-reach controls. Economical to operate. Available in capacities from 25 to 60 tons. For specification folder or further details, get in touch with our nearest representative or write us at Bay City.

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BROWNHOIST

Annual Reports (*Continued*)

sion. Capital expenditures in 1957 will total about $3-million ($1.5-million in 1956).

Calumet & Hecla, Inc. net sales were $66,665,511, for a net income of $4,012,642. Company will build a tube mill at London, Ontario. Total cost will be about $7-million. Capital expenditures in 1956 were $4.6-million.

Calumet has been exploring an encouraging uranium orebody in the Ambrosia Lakes area, N. M.

In Michigan, the company has nine shafts in operation and is developing ore reserves in several other locations. Calumet produced 37,813,735 lb copper in 1956. Production increased at Tamarack reclamation plant. And over one-million tons of tailings were processed from the Ahmeek bank, which has about ten more years production at present rate.

Crane Co.'s annual report states that Heavy Minerals Co. went into operation at Chattanooga in January 1957. The subsidiary produces rutile, ilmenite, zircon and thorium-bearing concentrates from its mining operations. Thorium-bearing material is refined at Chattanooga.

Cramet Inc., joint venture with Republic Steel Corp., is now turning out 4,000-ton per year and expects to reach 6,000 annual ton titanium sponge rate by year end. Net sales from Crane's valve business were $375,220,848 for a net income of $10,899,070.

Heavy Minerals and Cramet are not expected to add to Crane's dividend payments for several years.

Bunker Hill Co. the nation's second-largest lead mining firm, hit sales and ore extraction records during 1956.

President John D. Bradley announced that sales amounted to $56,976,000 compared with $54,082,000 in 1955.

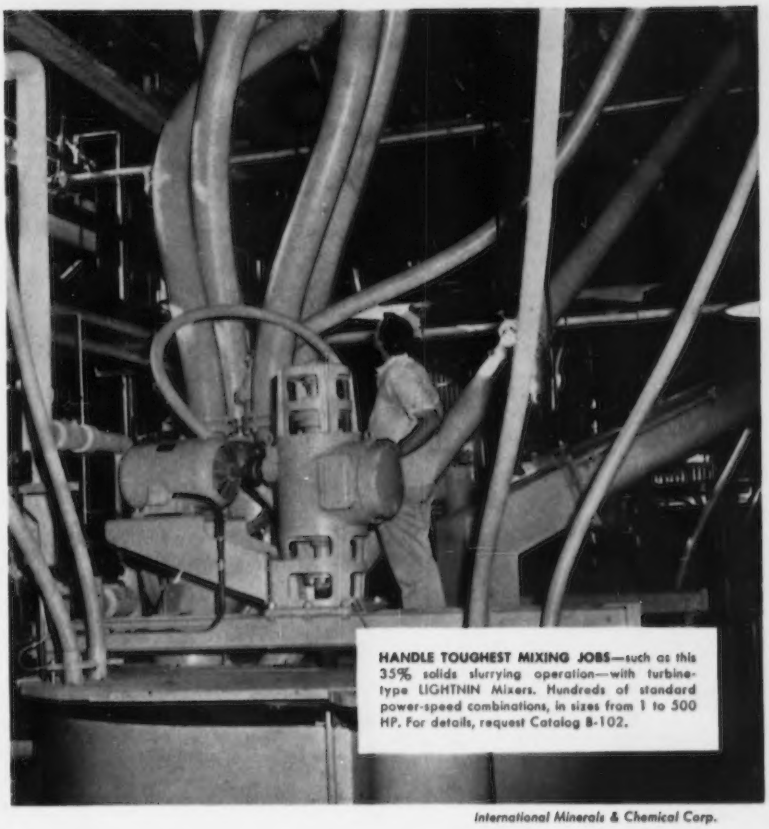
A new tonnage record was turned in for Bunker Hill lead mine at Kellogg, Ida.—531,334 tons. This output, added to the 189,821 tons produced at the firm's Star Mine at Burke, Idaho pushes total annual mine output to 721,155 tons.

Discussing the firm's development program, he said more was done in 1956 to increase proven reserves than in any recent year.

Company has programmed a $15-million expenditure for expansion over the next five years. Biggest projects are a $4.5-million expansion of the electrolytic zinc plant at Kellogg (it will boost capacity from 60,000 to 90,000 tons a year) and a $4-million program which includes modernization of the Kellogg lead smelter and construction of facilities for conversion of by-products into finished form.

Some $2-million (not included in the $4.5-million figure) has already been spent on the electrolytic zinc plant project, which was begun in 1955. It is scheduled for completion in 1958. Expansion program is expected to boost net earnings $1-million a year.

Bunker Hill has lead-zinc mines at Kellogg and Burke, Idaho reduction



HANDLE TOUGHEST MIXING JOBS—such as this 35% solids slurrying operation—with turbine-type LIGHTNIN Mixers. Hundreds of standard power-speed combinations, in sizes from 1 to 500 HP. For details, request Catalog B-102.

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Get more out of your ore
with this kind of fluid mixing

The way you mix fluids can make a big difference in profitability.

More efficient processing, higher extraction values, lower costs—these results are *typical* for processors who take a good hard look at fluid mixing operations, and then specify LIGHTNIN Mixers.

Where to use LIGHTNINs

Here are some of the operations where fluid mixing with LIGHTNINs can pay off for you:

1. Handling and blending ores in pulp form, to increase throughput, tighten quality control.

2. Conditioning feed for flotation cells, with minimum power input.

3. Leaching and dissolving to get optimum removal of mineral values.

4. Chemical reactions, particularly those where high mass transfer rates are important.

5. Controlling gas dispersions, to get highest possible gas-to-liquid transfer rates.

6. Mixing molten metal for high-speed refining and alloying.

Results guaranteed

You can get LIGHTNIN Mixers to handle any of these operations efficiently—in sizes ranging from ¼ to 500 HP. *Results are fully predictable, unconditionally guaranteed.*

You can always get LIGHTNIN replacement parts when you need them. And there's a skilled LIGHTNIN Mixer representative near you—ready to help you get fluid mixing that *does what you want it to do.* For more facts, look him up now in Thomas' Register. Or write us direct.

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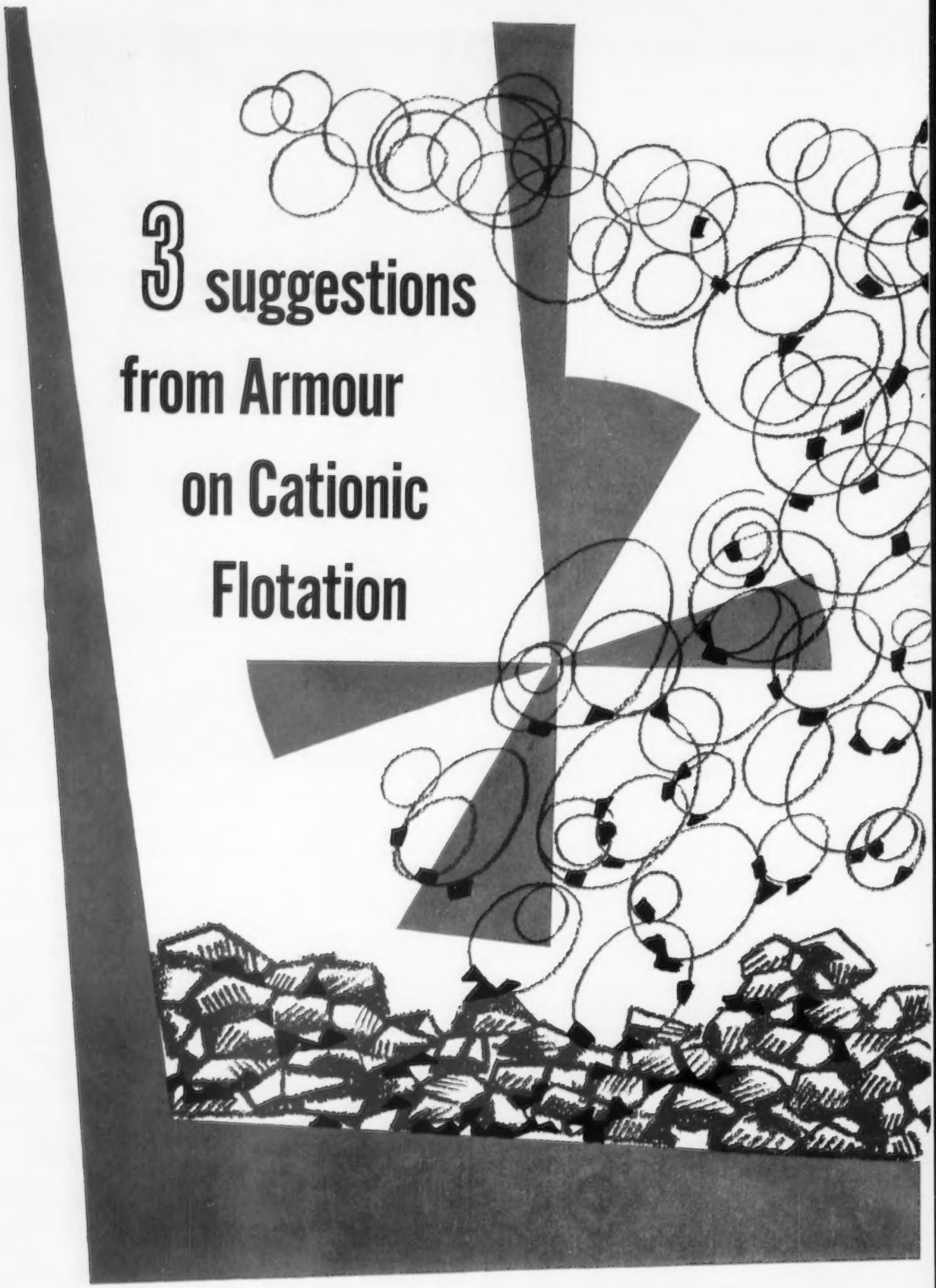
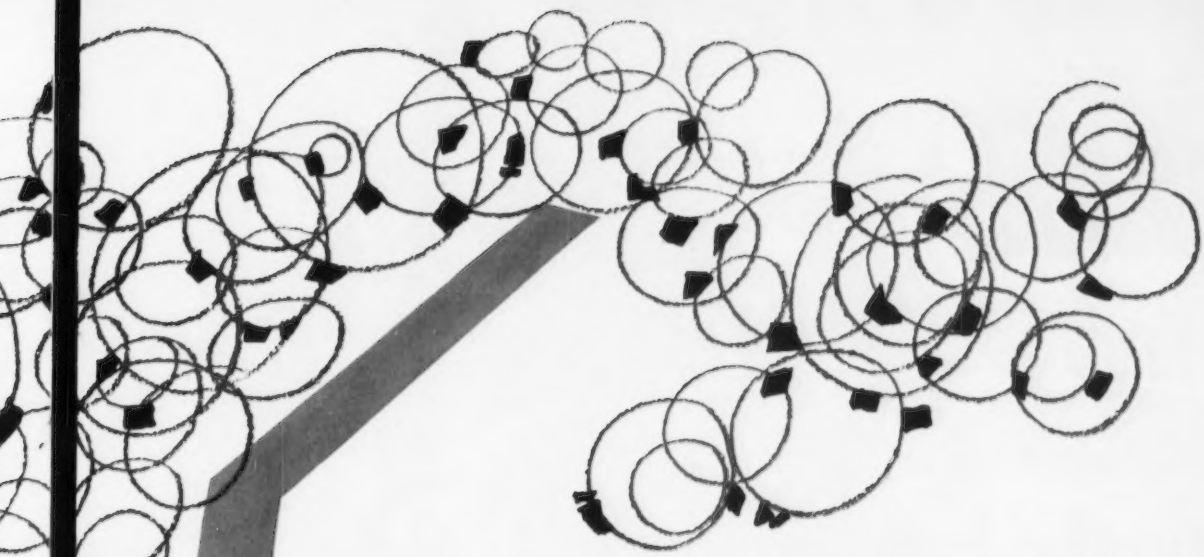

3 suggestions
from Armour
on Cationic
Flotation



1. Test this new cationic collector that needs no water solubilizing. New, low cost Armoflote® 54-38 is easier to handle and simpler to use than amines or amine acetates. Tailor-made for flotation of silica from phosphate rock and minerals from pegmatite. Liquefies between 80-100°F. Contains no inert solvents. Delivered in drums or tank cars and *can be blended with secondary collector or frother!* Stores indefinitely or can be used immediately. Send for sample and observe its greater tolerance to slimes and hard water.

2. Investigate the high quality performance of Armacs® in floating silica from iron oxides. The ore in the following typical test was a Mesabi taconite, a mixture of slatey and cherty taconites, holding magnetic iron (17.0 parts) and non-magnetic iron (15.7 parts), the remainder mostly silica. Grinding to 95% minus 100 mesh produced liberation. Desliming was necessary. Iron depressant was starch. Pulp pH: 10-11.

Lbs. Armac CD	Lbs. Frother	% Fe			Iron Recovery Based on original ore
		Silica Conc.	Middlings	Tailings	
0.80	0.20	6.27	29.62	59.9	77.9

Our flotation experts will be pleased to discuss your iron oxide flotation problems with you.

3. Explore these newly developed collectors that have shown exceptional promise in varied fields. Our research reveals the value of unusual new liquid amines and amine acetates in a wide variety of mineral separations. Request literature and samples for your own cationic flotation testing. Solubility data available.

Specifications of amine acetates (representative lots)

	Armac O	Armac OD
Iodine value	72.7	69.4
Primary amine acetate	89.6	98.5
Secondary amine acetate	6.3	2.0
Neutralization	99.0	96
Moisture	0.73%	0.89%
Cloud point	82°F	98°F
Pour point	40°F	65°F

The corresponding amines (Armeens® O and OD) are available for testing purposes. Request descriptive literature and sample.

• • •

Armour Cationic chemicals increase your recovery of the following minerals: *Amblygonite, Spodumene, Ilmenite, Phosphate, Barite, Beryl, Feldspar, Fluorspar, Hematite, Mica, Potash, Salt, Silica Vermiculite.*

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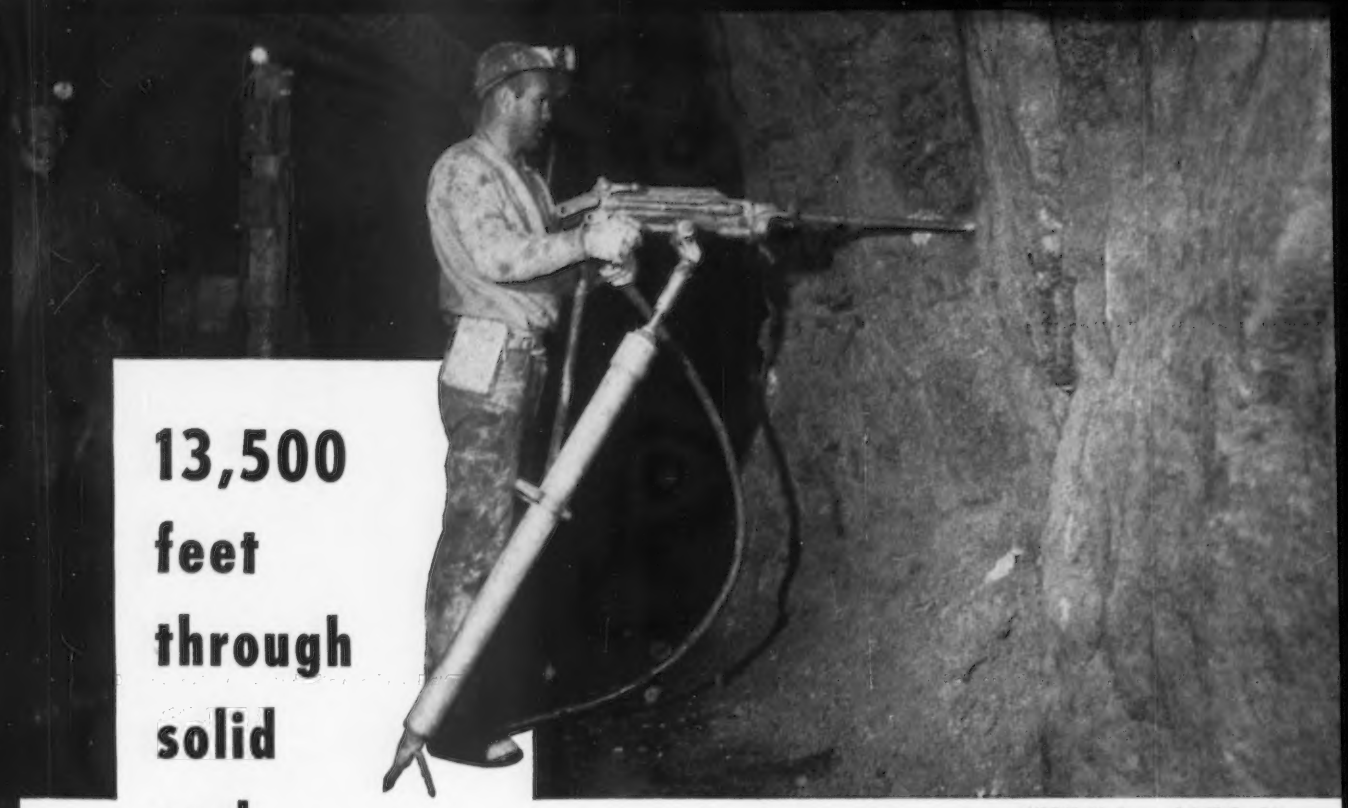

13,500 feet through solid rock...

H10AL Air Leg and Drill Combination at work. Note ease with which operator can adjust feed pressure.

yet maintenance cost only $48.00

Le Roi-Cleveland H10AL Air Leg, with superior construction and performance, keeps costs low.

Uranium mine reports increased footage, lower maintenance, when *Le Roi-Cleveland H10AL Air Leg and Drill Combinations are in use.*

Drilling an accumulated footage of two and one-half miles through solid rock is a real test of equipment. By keeping accurate records, one of the leading metal mines in the West found that the use of Le Roi-Cleveland H10AL Air Leg and Drill Combinations greatly reduced maintenance costs while increasing footage.

For drilling 13,500 feet of hole, this cost was only $48.00.

Ask the miner at the face. He may not be so directly concerned with overall operating and maintenance costs, but he will tell you that his work is easier and he gets more footage with a Le Roi-Cleveland H10AL Air Leg and Drill Combination.

The miner knows his tools; he takes pride in their performance. He favors too, the drill combination that makes his work easier so that he is less tired at the end of his shift. That means more work per man-hour and a major contribution to lower costs.

Easier-to-handle means more work per man-hour. Here are the reasons why the miner finds Le Roi-Cleveland H10AL Air Leg and Drill Combinations the easiest equipment to handle:

(1) Only Le Roi-Cleveland provides an air leg and drill with a built-in 11-position feed control — eliminating a third hose and cumbersome "Y" connections — reducing the weight he has to handle.

(2) The miner does not have to continuously bleed-off air to maintain suitable feeding pressure.

(3) He finds steel-changing easier, faster, with the new quick-opening steel puller.

Higher drilling speed regardless of varying rock conditions. Le Roi-Cleveland H10 Drill is one of the fastest drilling-sinkers made today. Combine this speed with the built-in feed control — providing 11 feeding positions from zero to full-line pressure, with an increase of 9-psi at each setting — and you have equipment with real production capacity and great stamina.

This is a feature that enables the miner to adjust the feed so that the drill is always down on the collar of the shank for maximum drilling speed, regardless of varying rock conditions.

Why maintenance is so low. Le Roi-Cleveland drills have stamina. They are built to take it. They stand up to the cruelest, hardest punishment that a drill can face — giving longer, better service.

Rotation strains are practically eliminated by the Le Roi-Cleveland Air Leg which holds the drill in line with the hole, reducing front-end drill wear.

Moreover, the new steel-puller helps to reduce maintenance costs still further. Consisting of only five parts, with one spring, one plunger, it's lubricated from the inside to prevent wear and to wash out dirt.

High drilling speed with low upkeep cost make Le Roi-Cleveland Rock Drills the first choice in mining equipment.

There are four types of Le Roi-Cleveland Air Legs available. Write for bulletin RD-30 that describes the Le Roi-Cleveland Air Leg in detail — the Air Leg that helps you get your round in faster at lower cost.

LE ROI Division of Westinghouse Air Brake Co.
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Annual Reports *(Continued)*

plants at Kellogg; fabricating plant at Seattle; and an interest in lead-zinc mines at Metaline Falls, Wash. (Pend Oreille Mines & Metals) and in Canada Reeves, MacDonald).

Quebec Labrador Development Co. Ltd. acquired two prospect properties during the year. Thirty-claim group in Lamarch Township, Chibougamau area, Quebec, was drilled (four holes totalling 1,500 ft) with inconclusive results. Other property was 64-claim group in Papaonga Lakes area. Surface exploration and ground geophysical work is being carried out on this large anomaly, indicating the presence of an iron-bearing formation.

Arcadia Nickel Corp. Ltd. is sinking a 2,000-ft shaft at its Sudbury area property, where some 5-million tons are assumed reasonable in the four ore zones. Company hopes to complete shaft and mill buildings by September 1957.

United Western Minerals holds over 550,000 acres of land in New Mexico, Utah and Colorado, reported that Section 32 in McKinley County, N. M. has some 450,000 tons 0.3% U_3O_8. In December 1956 UWM as a limited partner with Homestake-New Mexico Partners signed a contract with AEC to build a mill in Ambrosia Lakes area. Mill will have 750- to 1,500-tpd capacity. UWM has several farmount deals being drilled. UWM hold interest in Kerr McGee orebody in N. M. Reserves in this Section 22 orebody exceed 6-million tons 0.3% U_3O_8.

Rem-Cru Titanium, Inc. is currently undergoing expansion that will give the company 6,500 tons titanium ingot melting capacity in the first half of 1957.

Vacuum Metals Corp. is expanding vacuum metal facilities and will have 300,000 lb per month capacity when current expansion is completed.

Clayton Silver Mines Co., reports considerable reserves of uranium ore had been blocked out at the Ransom Mine, San Juan County, Utah.

Firm's annual report discloses that Clayton has acquired a one-sixth undivided interest in the King James and King Edward claims at the Blanding property.

Royalty interests were acquired in 1956.

Company's Coeur d'Alene properties experienced an exceptional year in 1956, despite a 30% hike in mining and milling costs and a 158% increase in taxation.

Some 120,000 tons of good-grade ore reserves are blocked out in the lead-silver-zinc properties, according to W. M. Yeaman, president. Net earnings of $179,491 were recorded for 1956.

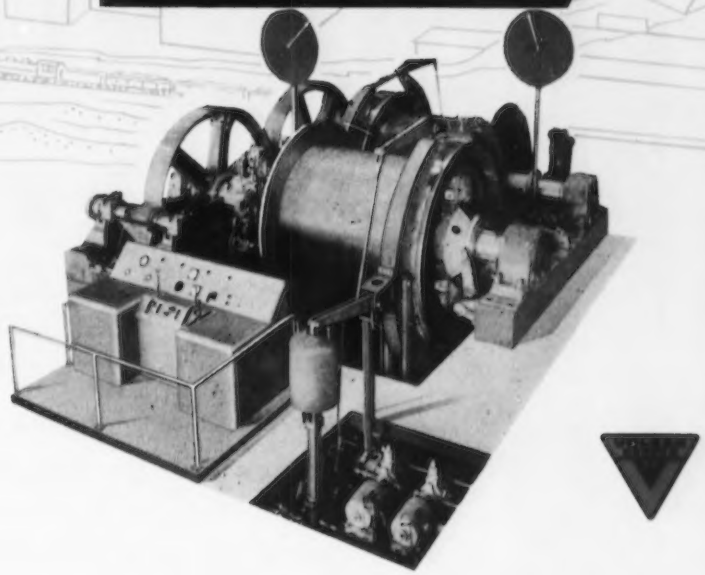
United Park City Mines Co. reported a net loss of $123,936 for the year 1956, attributed to unchanging lead and zinc quotations and an expanded exploration and development program at Park City, Utah, properties.

Officials said the loss could have been controlled only by retrenchment in ex-

new in copper country . . .

THIS VULCAN

TANDEM HOIST



Two of these Vulcan-Denver hoists have just been delivered for a double assignment. First they will be used in sinking a main shaft. Then they will be taken below ground for further use.

Because of the need to go through an opening about four feet square, each hoist breaks down into segments of suitable size. The design is such that this in no way affects the strength or traditional superior performance of Vulcan hoists. The dual drive is capable of putting the combined power of both drive motors into either drum for 30,000 lb. of rope pull. Clutches are radial acting dental type. All principal shaft bearings are anti-friction roller bearing.

These are only two of many Vulcan hoists working in "your kind" of service. Name your specifications...Vulcan can build to your needs from six decades of design experience.

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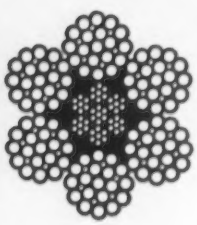
WIRE ROPE

An extra improved plow steel wire rope with independent wire rope core, Double Gray gives you a rated breaking strength that's 15% greater than the catalog breaking strength of ropes of the same size and type made from improved plow steel.

Double Gray is *not* a new rope . . . *not* a rope that's offered to you on an "experimental" basis. Instead, it's been thoroughly tested in both the field and the laboratory. This means that you can now get extra high strength ropes with greater abrasion and crushing resistance . . . *plus* the knowledge that you're using a *safe* wire rope that's made by a company long known for its top-quality products.

Contact your nearby Wickwire Distributor or CF&I sales office for complete details and recommendations for your particular applications.

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New Orleans • New York • Philadelphia

LOOK FOR THE YELLOW TRIANGLE

5078

Annual Reports (*Continued*)

ploration which, in turn, would have reduced furture mining possibilities at the historic properties.

While ore production increased over 1955, value content in terms of lead, gold and zinc was down. Silver and copper values were up slightly.

Reeves Macdonald Mines, Ltd. mined and milled 400,204 tons in 1956, Jens Jensen, president, said.

Jensen reported that an average of 130 men were employed at the lead zinc mine in southern British Columbia.

K.C. Li Hints at New Cb-Ta Separation Plan

HINT OF A NEW PROCESS to separate tantalum from columbium was given at Albany, Ore., by K. C. Li, head of the Wah Chang Corp. on a visit, Mar. 27, to the firm's zirconium purification plant there.

"We hope we may be able to announce soon the separation of tantalum from columbium through a procedure simpler than the present liquid-liquid method," Li said.

The new process is now being perfected in a small pilot installation within the new zirconium plant.

Li came to Albany from the firm's New York headquarters to conduct 70 Albany civic leaders on a preview tour of the corporation's two plants about a mile north of Albany. Until recently the zirconium purification building has been kept closed to public inspection by the Atomic Energy Commission.

Li said production of zirconium at the Albany plant has been pushed to 130% of designed capacity through new methods.

Accompanying Li were Lawton Geiger, Pittsburgh, Pa., AEC zirconium procurement officer, J. W. Simpson, manager of Westinghouse Electric's atomic power division, and Joe Stutzel, head of Wah Chang's mining division.

Spanish Aluminum Due

A NEW SPANISH CORPORATION, Sociedad Anonima para la Fabricacion de Aluminio, will build an aluminum plant in the Free Trade area in the harbor of Vigo, Galicia province. Establishment was made possible through development of new hydroelectric resources in the neighboring mountains.

Boron Facility Formed

MINE SAFETY APPLIANCES CO. and Gulf Oil Corp. have undertaken a joint program for research and production in the field of boron chemistry, including high energy fuels. The joint effort will be carried on by Callery Chemical Co., a pioneer developer of high energy boron compounds. Callery broke ground on a high energy fuel plant at Muskogee, Okla., under a $38-million contract with the Navy Department.

for Maximum Efficiency and Economy in all classes of separation and Concentration

• In heavy-media separation, Dings Wet Drum Magnetic Separators assure maximum recovery of magnetite and ferrosilicon . . . up to 99.8%.

In direct concentration service, selective separation possible with Dings design assures rejection of high tonnages of low iron non-magnetics in rod or ball mill cobber positions and consistently high grade silica-free concentrates from finisher separators.

Whatever your separation or concentration problem, over 50 years of specialized experience, backed by actual field trial where required, is available to assist you in selecting the best type of separator to solve your specific needs.

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For further details, send for Bulletin B-1500.

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WC155-2/3

P&H Electric Shovels

Illustrated is a P&H 1600—6 cu. yd. Electric Shovel. This is the third P&H Electric Shovel purchased by Dewey Portland Cement Company and one of six P&H machines used at their Davenport plant.

give you 95% Availability

Reports of 95% availability by users of P&H Electric Shovels are not at all unusual. This typically outstanding P&H performance is the result of these exclusive P&H designed and manufactured features!

MAGNETORQUE* . . . transmits power from the hoist motor to the dipper magnetically for faster action, and at the same time, eliminates shock and impact to the hoist gear train and motor. Response is immediate to varying load conditions.

ELECTRONIC CONTROLS . . . P&H designed and built to provide fastest action of any type of control available on electric shovels. All motions are smoother, resulting in consistently higher output.

P&H Basic Design . . . permits scientific weight distribution to insure maximum stability with higher bail pull. All-welded construction adds ruggedness and stability needed for the toughest jobs.

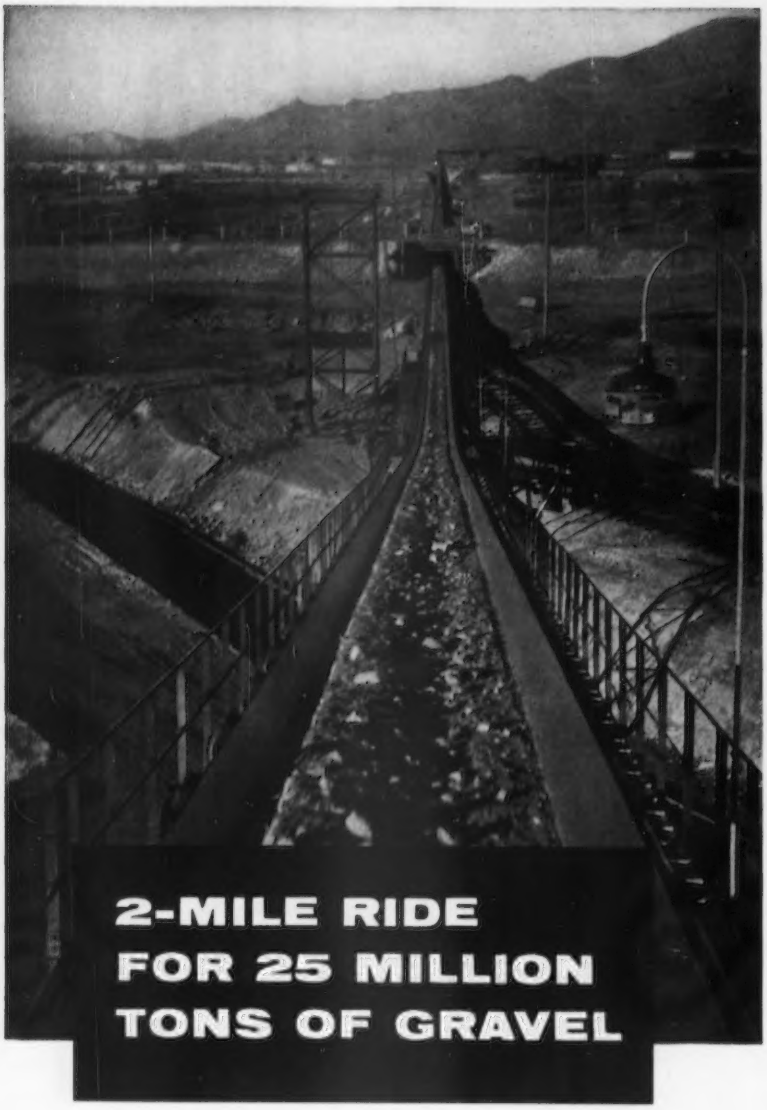
With P&H you get all of these exclusive electric shovel features . . . plus the advantage of single source responsibility. P&H designs, manufactures and applies all electric rotating equipment specifically for electric shovel service.

P&H ELECTRIC SHOVEL LINE: 3½ through 8 cu. yd. capacities.

HARNISCHFEGER

CONSTRUCTION & MINING DIVISION
Milwaukee 46, Wisconsin

*T.M. of Harnischfeger Corporation for electro-magnetic type coupling.



To help build Southern Pacific Railroad's 13-mile roadbed across Great Salt Lake, Morrison-Knudsen Co. had Hewitt-Robins develop a bulk materials handling system. In ton-miles-per-hour capacity, this system surpasses any previous belt conveyor installation. Its conveyors travel at speeds up to 850 fpm, carry 75,000 tons of rock and gravel per day, load barges at 12,000 tons per hour.

The entire installation—including 3 scalpers, 13 conveyors, 23,000 feet of belting, 4,700 idlers, a 164-ft. radial stacker, 10 belt feeders, 2 recovery conveyors and 27 speed reduction drives—was designed, manufactured and delivered by Hewitt-Robins in less than eight months. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

HR HEWITT-ROBINS

CONVEYOR BELTING AND IDLERS . . . POWER TRANSMISSION DRIVES
INDUSTRIAL HOSE . . . VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

Cobalt Institute Meets

FIRST GENERAL ASSEMBLY of the Cobalt Development Institute was held earlier this year at Brussels, Belgium. The organization is made up of the world's major producers with the purpose of improving "the existing uses of cobalt and to develop new ones."

The Belgian limited liability company "Centre d'Information du Cobalt" has been entrusted with the execution of the Institute's program. The Centre is located in Brussels, at 35, rue des Colonies, and is represented in the U. S. by the "Cobalt Information Center" at the Battelle Memorial Institute in Columbus, Ohio. A research program of fundamental studies is being sponsored and, through the dissemination of technical data, these informational centers assist users and potential users of cobalt.

CORRECTION

The January issue of *E&MJ* contained a typographical error in the article headed "AEC, Canada and France Reveal Uranium Reserves." Figures for France's ore reserves should have read 50- to 100-million tons.

Ilmenite in New Jersey

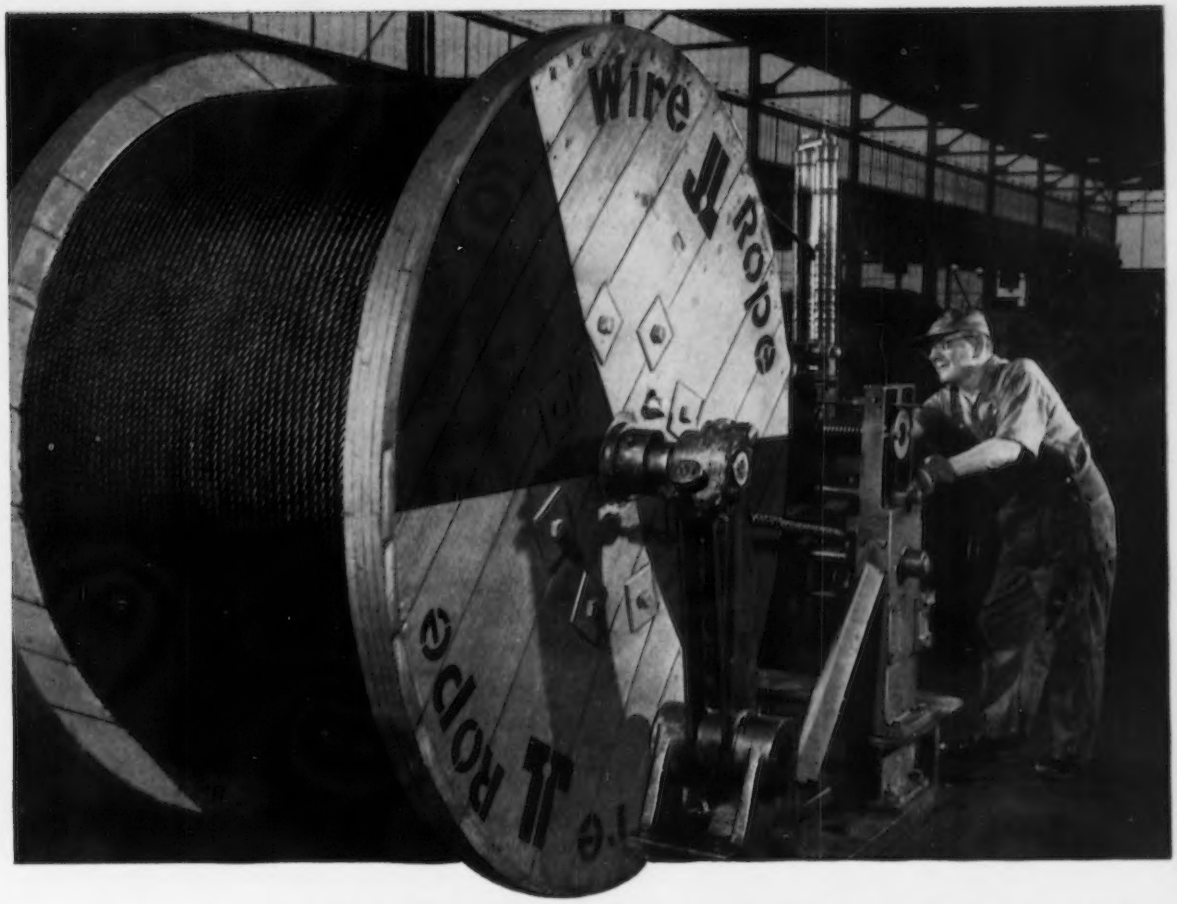
STATE COMMISSIONER of New Jersey Department of Conservation and Economic Development, John E. McLean, has announced that prospecting already done has shown that thousands of acres in some 250 sq miles of New Jersey's pine barrens contain ilmenite in commercial mineable amounts. At least a half-dozen large tracts are being sampled now by firms presently engaged in the manufacture of titanium pigment, or which are considering such manufacture or the production of metallic titanium. It is known that some tracts have already been optioned or acquired and it seems likely that within a year there will be definite plans for active mining operations.

IN THE U. S.

ALASKA

Kendrick Bay Mining Co. will sell uranium ore from its deposit on Prince of Wales Island to the Dawn Mining Co. at Ford, Wash., it has been announced by Frank Coolbaugh, president of Kendrick Bay. Company has contracted with Tom Monk of Ketchikan to build a dock and a road to the orebody near the west arm of Kendrick Bay. Monk Construction Co. will also be the prime contractor for mining ore and loading barges for shipment to the Puget Sound area. Operations were expected to begin by May 1.

Kendrick Bay Mining is owned by the Climax Molybdenum Co. and the Ketchikan prospecting group, headed by Don Ross and Kelly Adams, who dis-



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CenterFit is your best wire rope for back hoe pull ropes, shovel hoist ropes and clamshell holding and closing lines where overloading may occur. Here's why:

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Muncy, Pennsylvania

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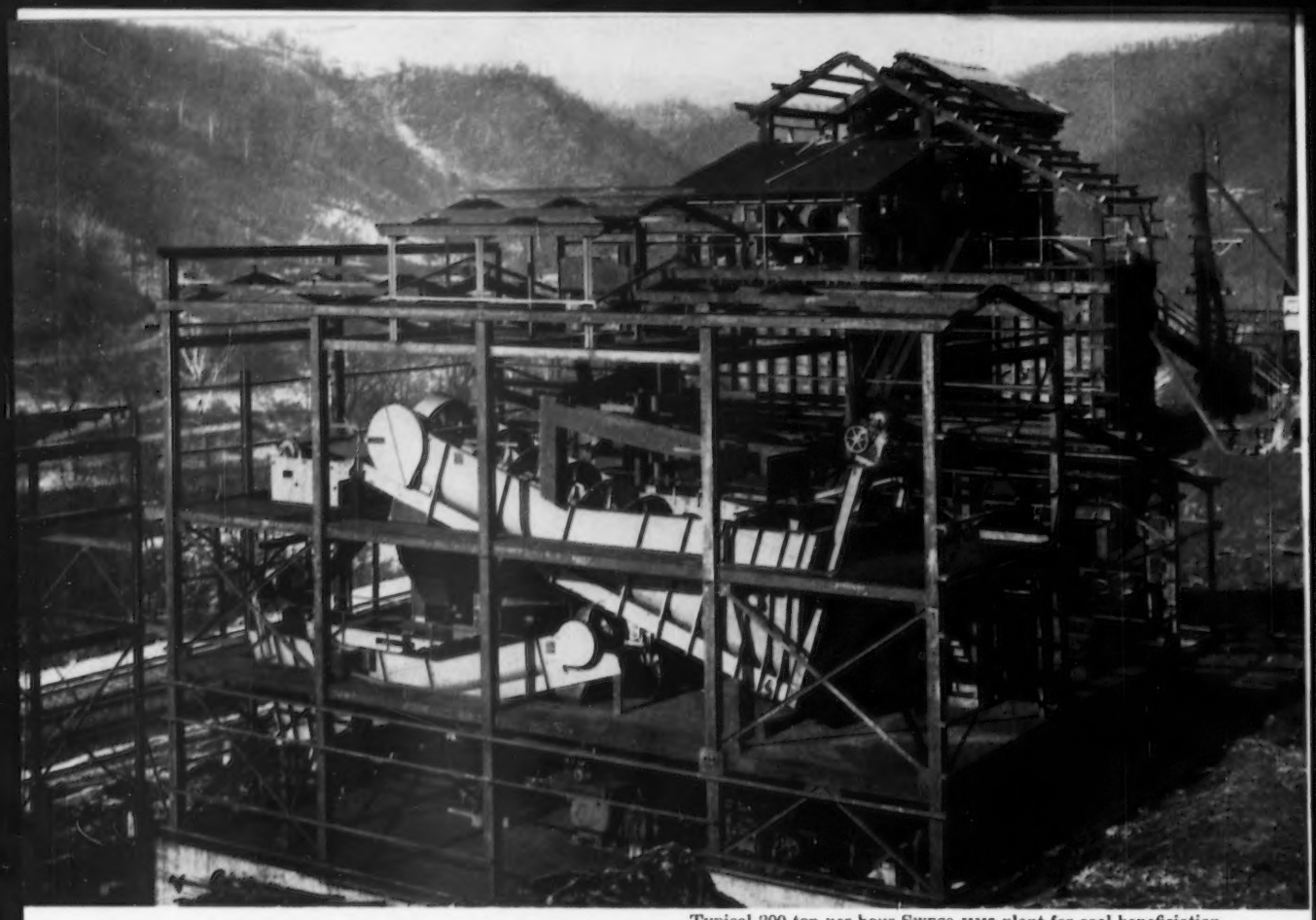

Typical 200 ton per hour SWECO HMS plant for coal beneficiation.

HMS Makes Waste Profitable

SWECO packaged HMS plants pay out in economical, peak recovery of ore and conversion of low-grade materials to profitable products.

Throughout the United States and in mining areas from Norway to Tanganyika, versatile SWECO Heavy-Media-Separation Plants are bringing greater yields to ore and coal beneficiation. These compact plants, with hourly capacities ranging from 10 to more than 200 tons, are profitably treating a wide variety of minerals, including submarginal ores and coals, coarse tailing from past operations, and waste dumps.

HMS Plants built by SWECO's Engineering and Construction Division operate on a sink-float technique, using a fluid medium of finely ground ferrosilicon or magnetite suspended in water. Heavier mineral components sink . . . lighter components float. The valuable middlings fraction between these extremes is recovered. With the Akins Separator – a feature of SWECO HMS plants – virtually all elements of value are recovered and waste is practically eliminated.

How SWECO HMS pays out

In replacing or supplementing more expensive beneficiating plants, SWECO HMS Plants pare down power needs. (A 100-ton/hour plant requires only 85 hp.) They consume little medium, and cost one-fifth to one-sixth as much to build as other units. Simple design and easy accessibility reduce supervision.

SWECO HMS Plants generally become permanent parts of mills, but can be quickly dismantled and reassembled. This makes them ideal for such short-lived operations as processing small deposits, mine dumps, contractors' gravel plants.

Analysis and recommendations

SWECO engineers will analyze your HMS application and provide estimates of operating costs as well as capital investment required. Call or write for information today. Ask for brochure E-4-12.

For more than 35 years, SWECO has specialized in the design and manufacture of *process equipment* . . . and in the *engineering and construction* of refineries, chemical plants and ore beneficiating mills. SWECO also manufactures a complete line of *vibrating screen separators.*

SWECO

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Alaska *(Continued)*

covered the first commercial uranium deposit in Alaska early in the summer of 1955.

ARIZONA

Uranium miners in Utah and Arizona suffered a recent "collision" of interests 93 ft under the border dividing the states.

David H. Crockett, geologist for the Utah State Land Board, said a survey has established that an Arizona mine on Navajo Indian Reservation recently bit off four feet of a chunk of Utah—93 ft underground.

A partnership, managed by Oscar Thomas, Farmington, N. M., is operating the Arizona mine under the Navajo lease. Radium Hill Uranium, Inc., Montrose, Colo., is on Utah side of the border on a state lease in San Juan County.

They both were following the same channel, Crockett relates, when a Radium Hill operator was pounding out drill holes in the uranium face. He suddenly encountered something less than ore—air.

The mine foreman discovered that the Indian lessees, following the same channel, had come within a few inches of the Utah properties.

Surveys were taken.

Arizona says there was no trespass, but still a few feet of leeway.

But Utah engineers of the state land board said the others were in the Beehive State about 4 ft.

CALIFORNIA

Sol Posner, president, National Tungsten Corp., Los Angeles, reported shipment of 1,150 short ton units of pure tungsten concentrate to Molybdenum Corp. of America. Shipment represents company's first sale of concentrate on the world market, Posner said. Company has stepped up production at the Tyler mill, Porterville to three shifts daily, five days a week, processing 105 to 107 tpd ore. Production is being stockpiled pending clarification of Government policies concerning purchase of strategic minerals.

In mid-March Kern Uranium Co., Bakersfield, shipped approximately 50 tons of uranium ore to Vitro Corp., Salt Lake City. Shipment was first made from the company's Little Sparkler claims in Kern Canyon, 36 miles northeast of Bakersfield in Kern County. Lloyd Scouler, president, reported an ore sample from a depth of 14 ft assayed at more than 10%. Sample was blackish ore believed to be uraninite or pitchblende. Company presently is sinking a shaft to better evaluate its claims.

Great Lakes Oil & Chemical Co., is in its third month of a corehole drilling program on the Kergon uranium claims in Kern Canyon, 36 miles northeast of Bakersfield. Company plans to drill about 10,000 ft of hole.

FOR LOW COST HANDLING AND CRUSHING of ★ROCK ★ORE ★SLAG ★MINE REFUSE ★LIMESTONE ★GYPSUM and other materials

McLANAHAN Heavy Duty RECIPROCATING PLATE FEEDER

Built to handle materials from the size of sand to shovel-loaded rock. Rate of material flow automatically controlled. Quickly adapted to production capacity of any machine.

A combination of McLanahan Reciprocating Plate Feeder and Rockmaster Crusher is your answer to the most economical feeding and crushing of large tonnages of rock, ore, limestone, and other materials. Furnished as separate units or in combination as required.

A GREAT COMBINATION

McLANAHAN Single Roll ROCKMASTER CRUSHER

Here is the economical solution to the most rugged crushing applications involving primary or (secondary) reduction of shovel-loaded rock and ore. Special features include —high capacity, low headroom and many other distinct advantages.

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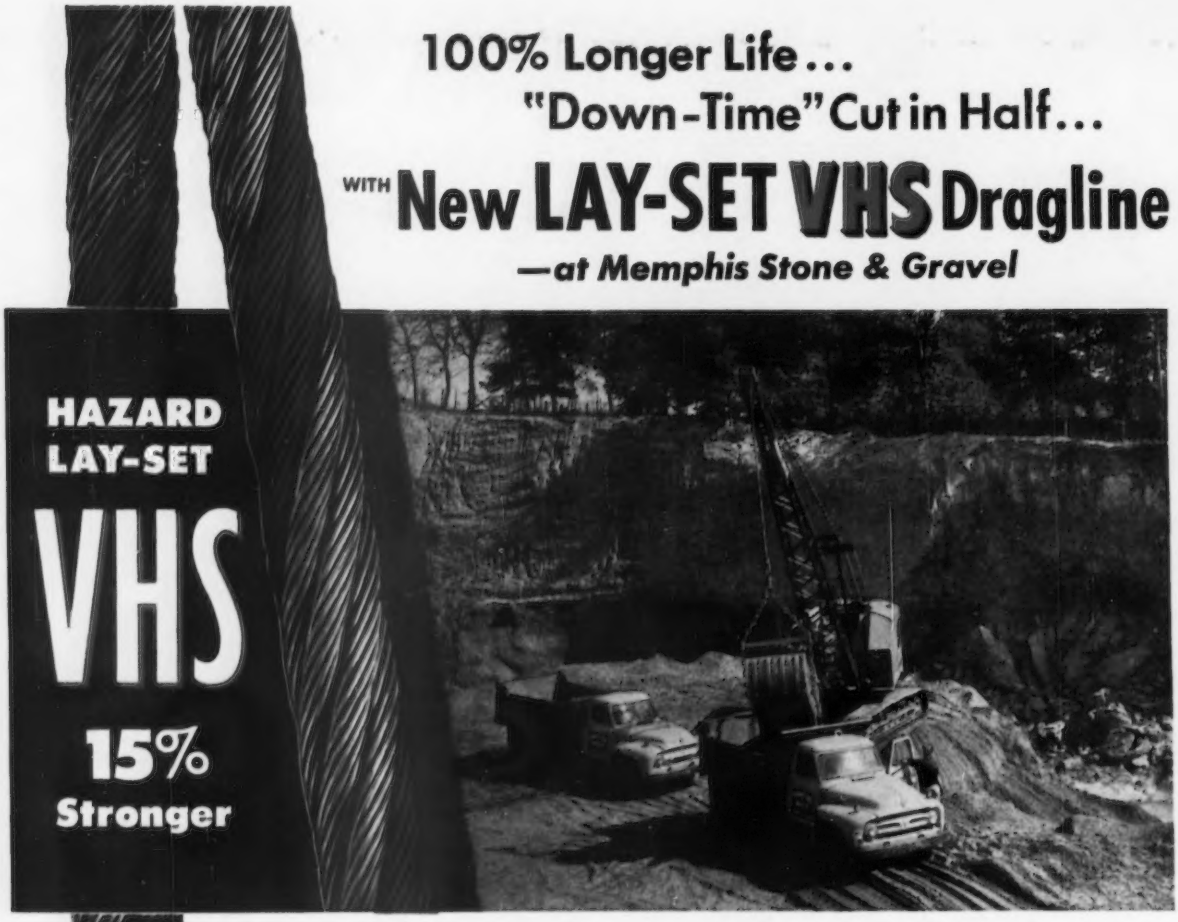

• Mr. L. C. Ring, Vice President, Memphis Stone & Gravel Company, Memphis, Tennessee, says: "Our No. 6 Northwest Dragline is used in an open pit on sand and gravel service. We were only getting about 50 hours of service from the best Improved Plow Steel Draglines we could buy. However, since we switched to new LAY-SET VHS we are averaging 102 hours, getting over twice as much service life.

"But the longer wire rope life is only part of the saving we are making with new VHS. By using this new, tougher wire rope, we have been able to cut equipment 'down-time' for wire rope replacement by over 50% —a very significant cost reduction."

New Grade of Steel

Enthusiastic users are reporting similar savings all over the country in the toughest wire rope applications—draglines, shovel hoist ropes, and winchlines. Developed specifically for these tough applications, new VHS (Very High Strength) wire rope is made from a new grade of steel . . . is at least 15% stronger than Improved Plow Steel, the strongest grade formerly available.

This allows you to handle heavier loads with the same diameter of line. It gives you a higher factor of safety . . . provides greater insurance against sudden over-stressing.

Tougher, More Wear-Resistant

In addition to its greater strength, new LAY-SET VHS is tougher. It resists abrasion . . . keeps its shape under pressure . . . can't become "hidebound" or lose its flexibility.

As a result, it lasts longer in the tough applications for which it was developed. And, as Mr. Ring and countless others can testify, this means important savings . . . both from reduced wire rope costs and the reduction of equipment "down-time."

At Your Distributor

Your nearby Hazard distributor has draglines, shovel hoist ropes and winchlines of new LAY-SET VHS. Call him today for speedy delivery. You don't need any complicated specifications in your order—just tell him the size and diameter you want.

For more information see your Hazard distributor salesman or write to the nearest Hazard office for Bulletin DH-513H

HAZARD WIRE ROPE DIVISION
American Chain & Cable Company, Inc.
Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.

California *(Continued)*

Diamond coring is being done with a skid-mounted rig. Depths range from 200 to 600 ft for holes drilled to date. Geologists George Schroeter and Bruce Lockwood, Los Angeles, are supervising the program.

Lake View Mining Co. has completed a corehole drilling program on the Knob Hill claims at Castle Buttes, 10 miles northeast of Mojave, Kern County. Company cut about 3,000 ft of hole. Lake View purchased claims from Wilson Call and Darl Ritter last fall for $200,000. Claims were located in November 1954 with occurrence classified as vein-type deposit in which uranium is carried as uranite in association with fluorite. Seven tons of acceptable ore were trucked to an AEC buying station at Marysvale, Utah, almost two years ago.

Bunker Hill Co. has acquired options on three properties, the company told stockholders at a recent annual meeting in San Francisco.

The firm would not reveal any details of the prospects, saying only that they are among the 49 properties investigated last year in the Western states and Canada. The three prospects will be tested this year.

In line with its stepped-up exploration program the company looked into 26 Latin American properties last year, but Bunker Hill did not indicate it plans to develop any of them.

The company operates the nation's largest lead mine—at Kellogg, Idaho—and it has undertaken a $15-million expansion of its concentrating facilities at Kellogg.

COLORADO

Valuation of $11,794,193 has been placed on buildings and equipment held by AEC in Western uranium areas, the Grand Junction Operations Office has announced.

The Government-owned uranium processing mill at Monticello, Utah, is carried on the books at $4,167,070. Buildings, land and equipment at the Grand Junction compound are valued at $5,658,909, and seven ore-buying stations over the West have an average value of $200,000.

AEC said total employment by that agency and its contractors has remained fairly constant for the last year, with 1,271 persons working on Mar. 1. The total included 102 employed by USGS.

Bald Eagle Mine, Clear Creek County, Colorado's biggest gold producer during 7½ months of operation in 1956, mined and sold to AS&R at Leadville, ore with a value of $239,740.62. Of this amount, gold constituted 52%, lead 27%, silver 12% and copper 9%. The ore averaged $31 per ton and the concentrates ran $196. As of Mar. 22, they have produced $355,000 in ore of 60 tpd. A 90-ft winze is now being driven and will be equipped with bucket hoist.

out of the factory into the ground . .

and a champion every foot of the way

J. K. Smit Diamond Drill Bits are designed and engineered in our own plant, and manufactured with one purpose in mind: to give you maximum cutting speed, plus the most economical footage under any possible hole conditions.

Problem	Solution
Non-abrasive formations	HARDHED matrix
Average drilling conditions	HARDHED 40 matrix
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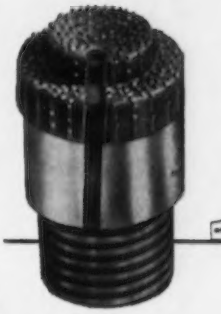

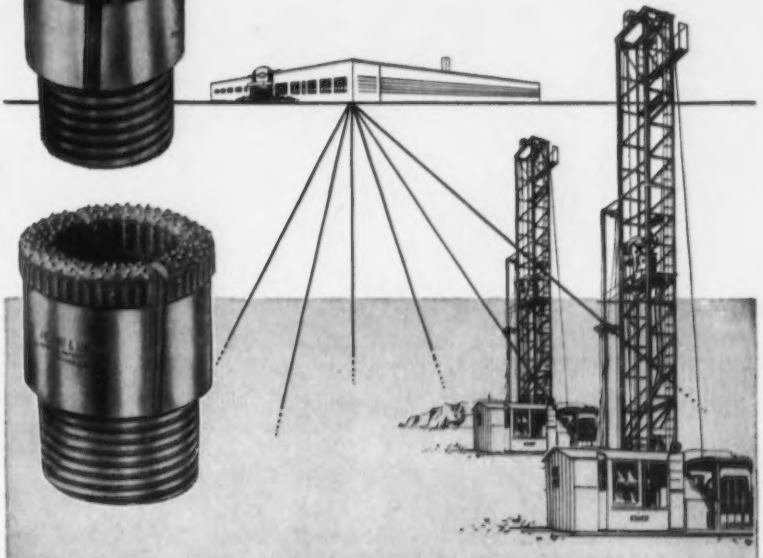

In addition, experienced personnel are at your service for consultation on any phase of diamond drilling.

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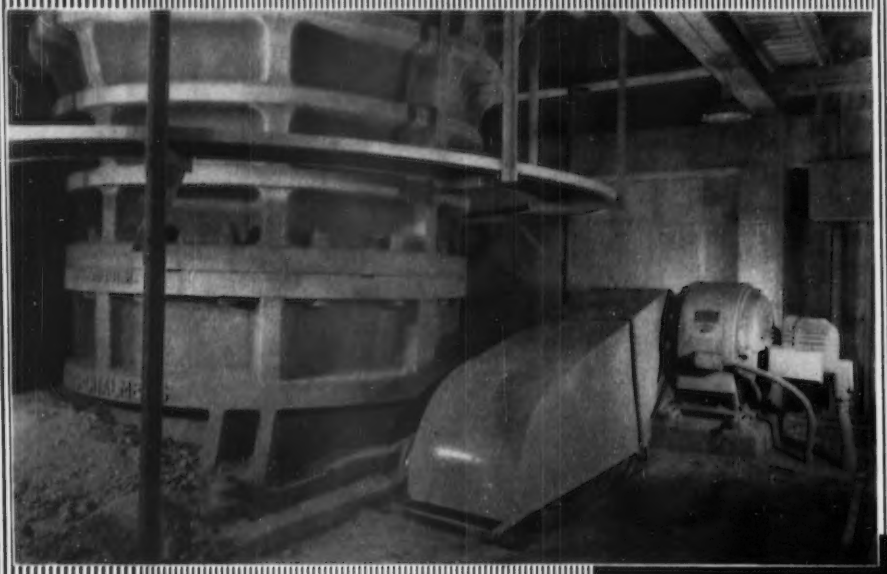
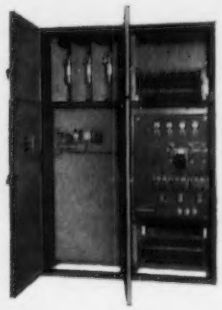
How "COORDINEERING" at ... Better

"Coordineering" may be defined as the integration of advanced thinking, planning and engineering that precedes the application of Allis-Chalmers equipment. With its staff, skill and experience, Allis-Chalmers is in a unique position to provide this valuable service.

Allis-Chalmers designs and builds all basic types





Crushing

An example of Allis-Chalmers "coordineering" is this crusher installation. Drawing on 75 years' experience in building and applying crushers, Allis-Chalmers control and crushing engineers developed a control circuit designed to cut costly downtime for the crusher installation shown above. In this circuit, motor overload protection is provided by *two* sets of thermal overload relays. One set operates at slight overload to sound warning. The second set stops the motor when temperature reaches the danger point.

Because of high starting torque and frequent starting under load, an Allis-Chalmers wound-rotor motor is used. In calculating horsepower requirements, the factors of crushability, ratio of reduction, product size and specific gravity are evaluated.

Flexibility in the Crusher

The crusher is the *Superior* gyratory crusher which features "one-man, one-minute" positioning of mainshaft and mantle. This control facilitates emptying crushing chamber in case of power failure or other emergencies. It also compensates for wear on concaves and mantle and, when required, changes product size instantly. In Allis-Chalmers gyratory crushers, changing eccentricity, speed, or shape of chamber varies capacity and product size. This flexibility permits synchronizing crushing with other operations.

Superior is an Allis-Chalmers trademark.

Hammermills

Vibrating Screens

Jaw and Gyratory Crushers

Grinding Mills

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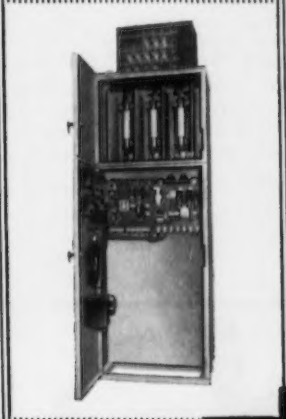
ALLIS-

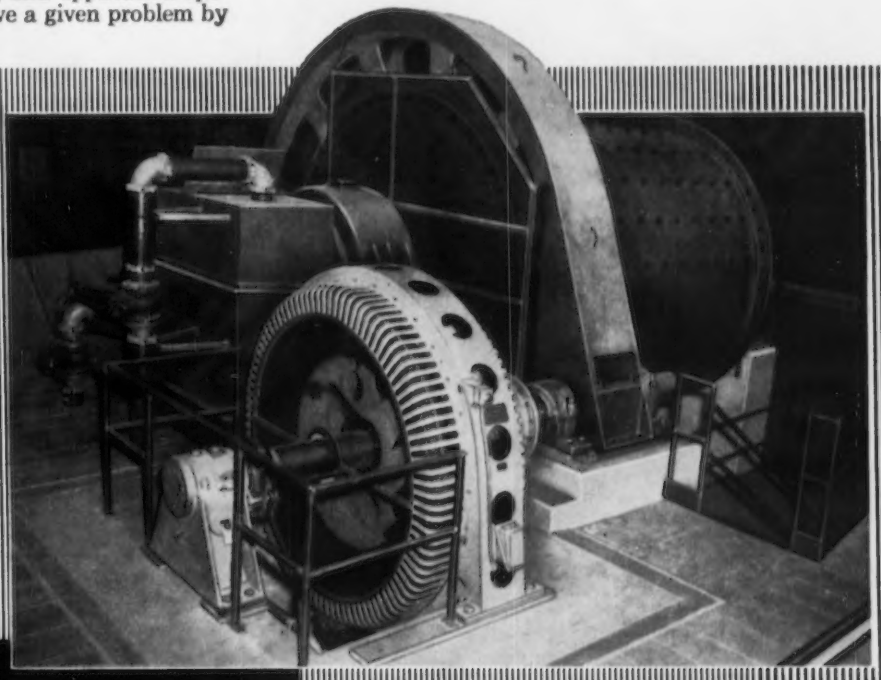
Allis-Chalmers Provides Better Methods

Results for You!

of processing machinery. In addition, the company manufactures complete lines of electrical generation, distribution and utilization equipment. As a result, Allis-Chalmers has a tremendous reservoir of experience — a most diversified team of research, engineering, manufacturing and application specialists — specialists who solve a given problem by exchanging ideas and correlating specific know-how and skills.

Only Allis-Chalmers can give you truly integrated equipment — because only Allis-Chalmers can give you "coordineering."





Grinding

In solving a grinding application, requirements and variables are given a careful going over by an Allis-Chalmers team comprised of *grinding*, *motor* and *control* engineers. Characteristics of material, capacity, feed preparation, balance of gradations, torque characteristics, system power factor needs, control requirements are some of the many factors evaluated. Experience has proved that this thorough pre-application investigation and preparation pays off to the purchaser . . . *pays off in providing a modern, efficient grinding circuit with the lowest operating cost.*

An Integrated Grinding Mill Installation

In a typical application, the mill installed was a 10½ by 12-foot Allis-Chalmers diaphragm ball mill. The close diameter-length ratio is an important factor in producing the highest possible capacity per unit of power. Driving the mill is a 900-hp, 4000-volt, 257-rpm, 0.8 pf Allis-Chalmers synchronous motor. By providing desired power factor correction, this motor reduces power cost. The Allis-Chalmers starter is specially engineered to provide protection under all conditions of grinding operation.

A-4915

★ **You'll want Bulletin 25C6166D.** It covers all equipment manufactured by Allis-Chalmers for the mining industries. See your nearby A-C representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

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EE PRODUCTS DO THE JOB BETTER AT LOWER COST!

Model EE20-9
integral two stage

Krebs Cyclones

Longs sweep inlet for better performance and capacity at lower psi. Molded replaceable pure gum rubber parts throughout. Adjustable apex valves for all sizes.

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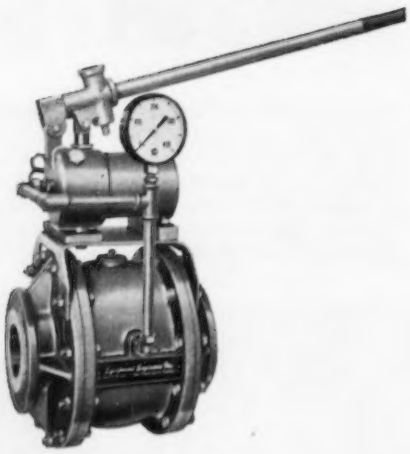

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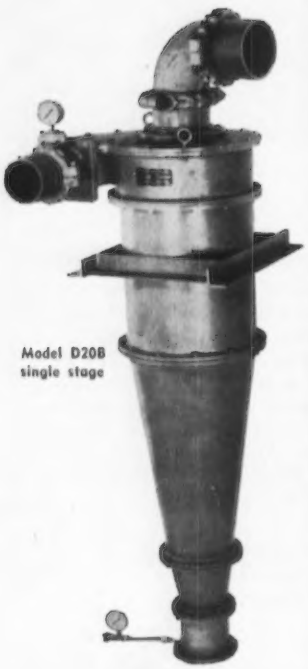
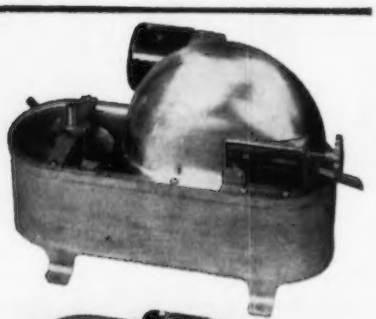
The round hole, center flow makes it the most efficient valve for heavy duty service. Knows no maintenance expense. Hydraulically operated—remote if desired. Write for performance curves showing quickly responsive control.



Model D20B
single stage



Model E in 18-8 stainless steel. Also available in duplex and triplex units.

Clarkson Reagent Feeders

The standard for precise and low cost feeding of reagents throughout the world. The Clarkson Company is a Division of EE Inc.

Model E in PVC for acids.

EQUIPMENT ENGINEERS INC.

41 SUTTER STREET SAN FRANCISCO 4, CALIFORNIA

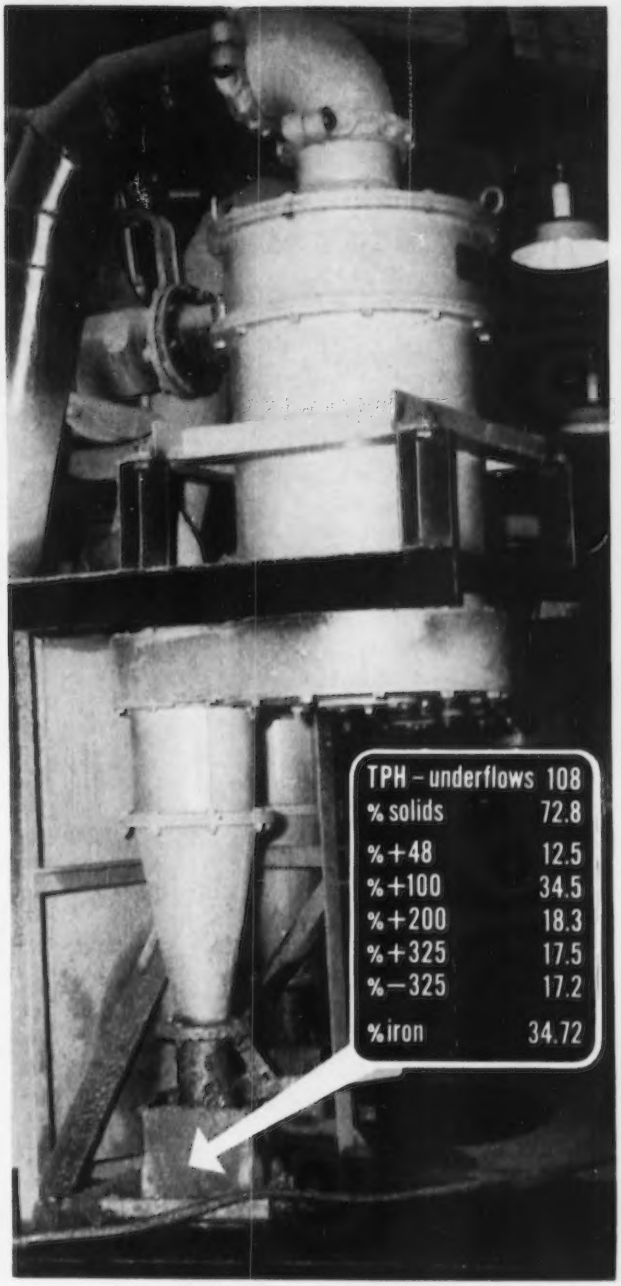
Here is a new technique for recovery of values from tailings

A new economical method for additional recovery was developed in 1954 at this Mesabi Range iron ore beneficiation plant by the use of Krebs Cyclones. A battery of 10 Model EE20-9B integral two stage Krebs Cyclones* handles 5840 gpm (281tph) with the primary overflow rejecting paint slime and the secondary overflow rejecting fine sizes high in silica and low in iron. This is an exceptionally sharp split. Upgrading from 20.75% Fe to 34.72% Fe into crystalline sizes makes an ideal feed for the subsequent concentration to required grade.

This recovery technique has now been adopted by 14 other iron plants throughout the world and has also been applied to tailings from plants handling ores of chrome, manganese, copper, lead-zinc, tin, tungsten, gold-silver.

We invite you to consult us on the advantages of Krebs Cyclones to your operations.

*Patented



KREBS INTEGRAL TWO STAGE CYCLONE

EE PRODUCTS

EQUIPMENT ENGINEERS INC.

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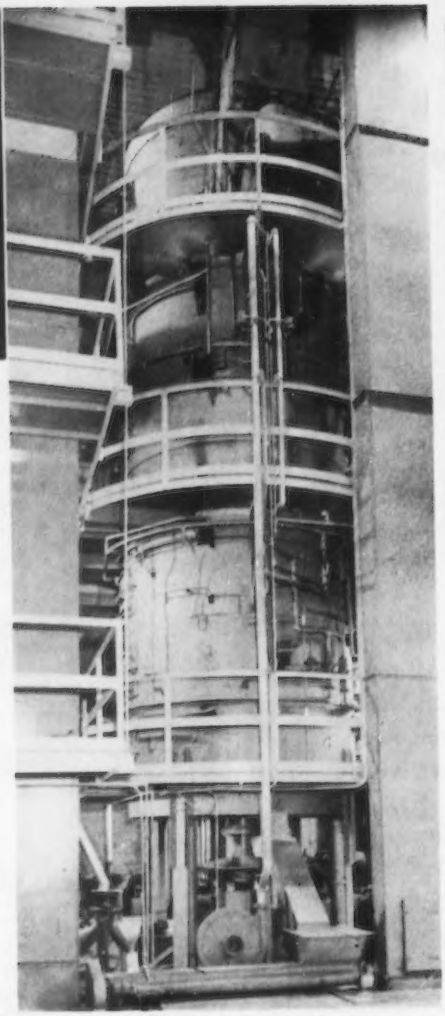
Manufacturers of Krebs Cyclones, Valves and Clarkson Feeders

SKINNER ROASTER at SHATTUCK CHEMICAL



The S. W. Shattuck Chemical Company's new, modern plant in Denver, includes an 8' I.D., 8 hearth gas-fired Skinner Roaster for roasting molybdenum concentrates.

PROVED ON MANY APPLICATIONS FOR 38 YEARS

Skinner... proved for 38 years for efficient roasting and drying of ores, clays, limestone, lime sludge... including sulphide roasting; oxidizing, reducing and chloridizing roasts.

Mechanical Features — Skinner Roasters consist of a series of superimposed hearths over which the material is rabbled by rotating arms and easily replaceable teeth. The rabble arms are fastened to the central shaft by means of the distinctive Skinner bayonet lock. The shaft is constructed to allow for ample cooling of both shaft and arms from a blower or by natural draft. Among the distinctive advantages of CIW Skinner Roasters are: small diameter rugged center shaft increases net hearth area and volume; simple vertical adjustment of central shaft; quick replacement of rabble arms and teeth without cooling; up or down-draft and multiple hearth gas off-takes permit wide range of control; negligible dust losses. Coal, oil or gas fired. Sizes 2 to 12 hearths; 4'-0" to 23'-6" inside diameter.

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A SUBSIDIARY OF THE MINE & SMELTER SUPPLY CO.

Colorado *(Continued)*

Federal Government will open for mine claiming July 20 about 95,216 acres of public land and 3,920 acres of private land in southwestern Colorado. It is in the general area of rich uranium-bearing ore deposits.

Max Caplan, Colorado supervisor of the U. S. Bureau of Land Management, said the staking of mining claims will begin at 10 am.

Federal officials said they were advising state and local officers to take steps to guard against a disorderly rush of prospectors in the area.

The land is in Montrose and San Miguel Counties, generally between the San Miguel and Dolores Rivers and west, northwest and southwest of the towns of Nucla and Naturita.

The acreage was withdrawn from the public domain by the Atomic Energy Commission for exploration for fissionable materials. The oldest withdrawal dates back to Mar. 25, 1948 and the most recent was Mar. 11, 1955.

The AEC requested restoration of the areas to the public domain since officials felt more exploration by the U. S. Government was not justified.

The Grand Junction, Colo., office of the AEC, on the day the lands are opened for claims staking, will make available for public inspection its exploration data of the area. This will include drilling logs.

Federally-owned mineral deposits in the private lands render them subject to mining location, Caplan said.

Some 700,000 ft of drill cores from over the West are being catalogued by staff of the U. S. Bureau of Mines library at the Denver Federal Center in preparation for opening of a special drill core library.

Similar library, with cores from Eastern and Southern sections of U. S., will be set up at Minneapolis, Minn.

John H. East Jr., regional Bureau of Mines director at Denver, said "These two centralized locations will make it much easier for geologists, mining engineers and others interested in mineral resources, to study the earth's interior. It's a step well worthwhile for the mining industry as a whole."

Cores formerly stored at Salt Lake City, Tucson, Reno and Albany, Ore., now are included in Denver library.

Construction has started in Denver on a new laboratory and assembly plant for the Scientific Research Corp. which will introduce several new techniques to the West's mining industry. Colorado's Governor Stephen L. R. McNichols participated in the ground-breaking ceremonies. The new $75,000 plant will be used for assembling a new type of supersonic centrifugal dry-grinding mill which will reportedly extract metals in powdered form at the mine site, thus cutting high transportation and smelting costs.

Offices of the new corporation are located at 210 Mercantile Bldg. in Denver. Officers include Carl H. Peterson, Denver mining man, secretary-treasurer, and Alan T. McClure of Chicago, vice president. Directors include Dr. Nils

Here's what to look for in a Shell and Plug...

1 Two-piece shell of O-B Bail-Type flexes easily, doesn't resist expansion forces created by bolt tension. Result is a quick-setting unit with more useful expansion force per ft./lb. of torque.

2 Three-step taper in O-B plug is designed to take up the slack in the bolt hole fast, develop a powerful "socket" anchorage, prevent high unit stresses at extreme top edge of plug.

3 Horizontal section of expanded O-B unit shows four-way expansion of shell fingers. Four-way distribution of stress permits high loading without distorting plug or pinching bolt threads.

4 Vertical section of expanded O-B unit shows solid "stack-up" of metal in bolt, shell, and plug. This solid metal contributes to superior strength of the socket formed by the plug.

5 Sectioned pieces of expanded O-B unit show heaviest markings in middle or "socket" area of plug. Lighter markings at top of plug prove excellent stress distribution at point of greatest expansion.

6 Section of steel pipe in which O-B unit was expanded for test shows that expansion forces are distributed evenly over all four shell fingers. Serrations on shell fingers make clean sharp impressions.

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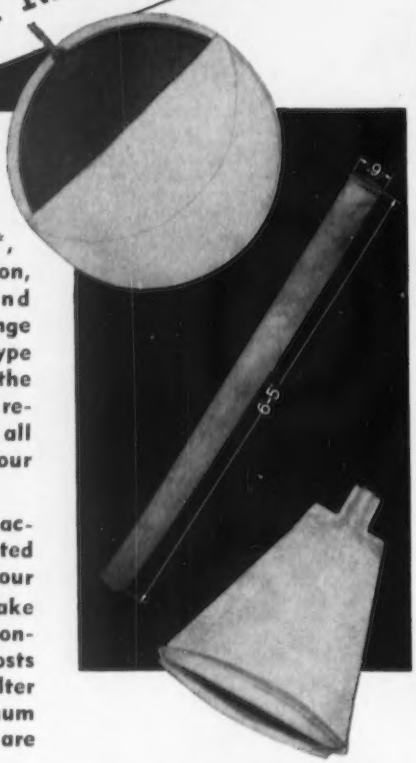
O B

SHELLS AND PLUGS

480

- Vacuum and Pressure Filter Element Covers
- Dust Collector Tubes, Bags and Envelopes
- Anode Bags

Let US make up your Element Coverings from NFM Filter Media



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NFM element coverings are accurately and durably fabricated by skilled personnel at both our New Haven and Salt Lake plants. Experience has demonstrated that filter cloth costs are at a minimum and filter performance at a maximum wherever NFM products are employed.

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Johannesburg, South Africa: Edward L. Bateman

Colorado *(Continued)*

Brundin, technical consultant of Hoganas, Sweden; Dr. Sven Palmquist, technical consultant of Fagersta, Sweden; Alva Garrett, Denver metallurgical consultant; and Allison L. Bayles, Pittsburgh.

Philip D. Wilson has been elected president of Pinnacle Exploration, Inc. Corporation was recently formed by Callahan Zinc-Lead Co. and its subsidiary, Vulcan Silver-Lead Corp., in order to conduct exploration work near Gunnison. Both Callahan and Vulcan have transferred to Pinnacle their interests in that area. James E. Dunn is the local manager with an office in Gunnison.

First ore shipments were made in March from a new uranium discovery 8 miles northwest of Craig made by Southwest Exploration & Development Co. L. N. Oliphant Jr., one of three partners in the company, said a strip operation is planned since only about 24 ft of overburden at present. The mine is called the Doc Armour and is on private land.

Silver receipts at the Denver mint in February dropped to the lowest level in years. Mint officials said the silver received was mostly integral parts of gold shipments. The small receipts are attributable to the world price of silver, which has been above the fixed U. S. Government price for some time.

Rocky Mountain Standard through its manager, Harry Culver of Boulder, announces that it has completed negotiations with L. E. Lindquist for placing an upgrading plant for uranium ore in the Yellow Cat area of eastern Utah, where Lindquist owns 53 claims. Rocky Mountain Standard has been demonstrating in its Denver laboratories a process for upgrading uranium ores.

Denver Water Board may strike ore while drilling the 23-mile Roberts Water tunnel beneath the Continental Divide to bring water from the West to Denver. Project engineer Earl Mosley said drillers also might find lead and zinc and maybe silver and gold. Geologists have advised the water board a "mineralized zone" with "sulphide veins" probably will be encountered between "mile 10.8 and mile 11.9."

Oil and uranium shared time in papers read at the third annual symposium of the Grand Junction Geological Society, held at Grand Junction April 5-6.

Scheduled papers included one by George Herman and C. A. Barkell of Salt Lake City on the Aneth and Paradox Basin oil fields, and one by Raymond Robeck, consulting geologist of Grand Junction, on "Geology of the Aneth Oil Field." During the meeting S. W. Lohman of Denver presented a paper on geology and artesian water supply of the Grand Junction area.

Other scheduled speakers: Charles P. Bromley of Casper, Wyo.; C. S. Robinson of Denver, Jerry F. Whalen of Rawlins, Wyo.; Milton Genes of Uravan; John Patterson and D. P. Elston, both Grand Junction; J. E. Dunn, Salida; S. J. Russon, Grand Junction; R. E. Cohen-

Why Falk Gears cost less per year of service

Experienced mill and kiln operators and engineers know that annual gear expense is determined by many factors besides the initial cost of the gears themselves. Among these factors are: tonnage handled, efficiency, and effect of gear operation on driving and driven machinery, shutdowns caused by gear failures or pinion replacements—and the service life of the gears.

By any, or all, of these standards, Falk Helical Gears are the most economical gears you can buy! They are *correctly designed, engineered and built* for highest accuracy, thanks to Falk's long and unmatched experience. All gears are *precision-hobbed* on machines designed and built by Falk. Each gear has a serial number; its pedigree is established during its course through the several shops and the many operations and tests to which it is subjected.

Repeated tests have proved that Falk Helical Gears have an efficiency of 98½% or greater—the highest obtainable!

These gears, with the smooth operation of their extra-capacity teeth, provide maximum resistance to abrasive wear—hence longer life, not only of the gears, but of driving and driven machinery. This means multiple savings for you.

Falk is the country's largest supplier of precision gearing...and has unsurpassed facilities to fill all your gear requirements.

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FALK HOBBED GEARS FOR IMPORTANT CEMENT MILLS

The 2000 hp helical gear in the small photograph above is one of six destined to drive important cement mills, probably the largest mills built to date.

All Falk Helical Gears, both single and herringbone, are precision-hobbed on special Falk-built hobbers of highest accuracy. Falk gear hobbers have incorporated in the design of the gear train a mechanism which is extremely effective in reducing tooth-spacing errors to negligible values. The accuracy inherent in the machines has the salutary effect of insuring perfect load division between the several teeth that are simultaneously in contact in helical gears.

Finish hobbing is done in a room where the temperature is controlled within a variation of two degrees. This is a precaution against possible dimensional changes of the gear during the all-important finishing operation—changes which might affect ultimate accuracy.

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US RUBBER CONVEYOR BELTS

Three Thousand and One Nights . . .

2000 ft. 36″ U. S. Matchless® belt with 6-ply Style YN cotton-nylon construction. Installed in the spring of 1949, it carries 6″ ore from primary to secondary crusher, up a 17½° grade. Note excellent condition and troughability, even after 8 years' service.

24″ U. S. Giant® belt, also installed in 1949, carries 3⅛″ ore up an 18° grade to the storage bins. It has handled more tonnage in less time—and with greater efficiency—than any previous conveyor belts.

Here in Bagdad—Bagdad, Arizona, that is—one of the leading primary copper companies extracts and processes sulphide copper ore at a highly efficient rate.

Helping to maintain this efficiency is the first patented "U. S." cotton-nylon conveyor belt ever put in a copper mill. Installed to carry 6" ore up a steep slope from the primary crusher to the secondary crusher, this U. S. Matchless belt began its operation early in 1949—three thousand and one nights ago.

Says the General Superintendent at Bagdad: "The belt has given excellent service, and we should get at least 2 or 3 more years of the same remarkable service from it."

Here's why Bagdad officials are so pleased with the belt:

- Belt has been on the job for 8 years.
- It operates 365 days a year.
- It has hauled over 10 million tons up a 17½° grade.
- Cost per ton is only 1/5 of a cent.
- The belt has required only minor maintenance.

For any materials handling problem, a complete line of conveyor belting—plus expert engineering assistance—is available at any of the 28 "U. S." District Sales Offices, at selected "U. S." distributors, or contact U. S. Rubber, Mechanical Goods Division, Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

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. . . with mining's best-proved torque converter tractors
. . . backed by 17 years of on-the-job experience
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More efficient dozing—Matched engine-converter-transmission team lets operator choose speed range for each job as he starts . . . finish most jobs without further clutching or shifting (except for reverse). With full control at throttle, he can work safely and efficiently regardless of terrain.

Faster on tough scraper jobs—These Allis-Chalmers tractors multiply torque up to four and a half times . . . develop maximum drawbar pull when it's needed most . . . start the load smoothly regardless of material in the cut . . . automatically accelerate to the highest speed that conditions permit.

Nothing like 'em on big loading jobs—The 3-yard HD-16G and 4-yard HD-21G tractor shovels are tough, mobile, flexible enough to pay big dividends on many projects. Operators can crowd surely and steadily . . . without stalling, shifting gears or losing control of the bucket because of slow engine speeds.

No construction equipment dealer in your area knows torque converter tractors as well as your Allis-Chalmers dealer. See him . . . and get the benefits of 17 years' experience working for you. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

Longer life for big equipment—Hydraulic torque converter cushioning reduces shock and vibration on the power train, the entire tractor and its auxiliary equipment—mounted or drawn. That means less downtime, more production time . . . better profit protection on any job!

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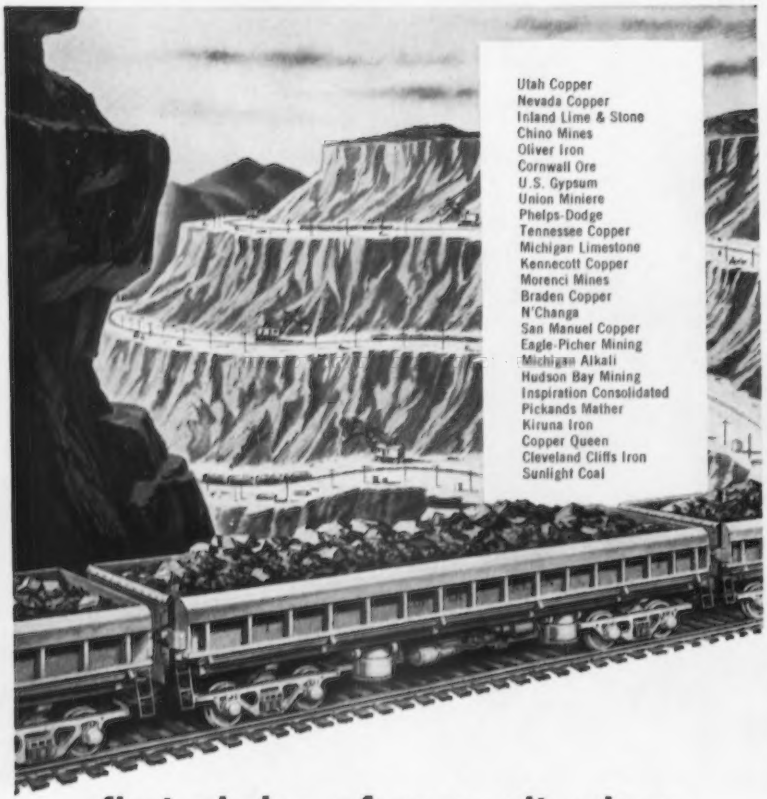
Engineering in Action

Western dump cars...



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Here's why more open pit mines use Western dump cars than any other make:

- Fast acting dumping mechanism and steep dumping angle speed up operation, cut costs.
- Exclusive dual side pivots permit dumping with least effort and air consumption.
- Door control mechanism, located at ends of car, is rugged, enclosed, foolproof.
- Body underframe is one all-welded unit heavily reinforced throughout to prolong car life.
- Double-plate, curved-top door is strongest made.
- Low center of gravity assures stability *at all times*. Body does not sway in transit.

Write today for complete information on Western, the world's largest selling dump cars.

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Colorado *(Continued)*

our, Salt Lake City; J. H. Steward and F. G. Poole, Grand Junction; M. D. Picard, Casper, Wyo.; R. A. Laverty, Grand Junction; Harold Kirkemo, Washington, D. C.; D. S. Turner, Denver; T. A. Steven, Denver; L. C. Huff and F. G. Lesure, Denver; H. S. Johnson, Grand Junction; L. S. Hilper and Carl Roach, Grand Junction; George I. Haines Jr. and R. C. Barkley, Rapid City, S. D.

IDAHO

Sunshine's deep exploration drift on the 3850-ft level of the Chester vein recently opened a good ore zone along the hanging wall of the structure directly below the rich ore shoot found last year on the 3700-ft level. Production from this area of Sunshine's workings, known as the Rotbart area, is shared equally by Sunshine, Polaris and Silver Dollar mining companies.

Other new exploration now in progress is a north crosscut from the newly-established 4,000-level of the main Jewell shaft to open the downward extension of the Silver-Syndicate orebody in which Sunshine was a 50% interest. The vein is estimated to lie about 250 ft north of the shaft on this horizon.

A flurry of claim-staking was touched off recently in the Fourth of July Canyon area in Kootenai County east of Coeur d'Alene when a bulldozer preparing road bed for the new U. S. Highway 10 project uncovered a good showing of lead-silver ore. The ore was cut about two miles west of the top of Fourth of July pass, in an area where there has been little exploration activity in the past, and within a few days the immediate area on both sides of the highway had been staked. Initial staking was done by flashlight the night following the discovery by workers on the road project.

The mineralized vein is about 18 in. wide. A random sample assayed 4.5% lead, 4.6% zinc, 4.8 oz silver and 0.7% copper.

San Francisco Chemical Co., Montpelier, plans immediate work on 360 acres of phosphate leases obtained late in March as result of successful bidding in a Government letting.

The lease is immediately north of Bear Lake County line in the Swan Lake phosphate rock mining district.

D. L. King, president of San Francisco Chemical, said high grade phosphate material will be strip-mined and sent to market.

Lower grade phosphatic shales will be stockpiled and either sent directly to markets for application to soils or to Leefe, Wyo., for beneficiation.

The D-5 vein which Nabob Silver-Lead Co. is developing at its property in the Pine Creek area of the Coeur d'Alene District is beginning to show promise of proving to be an orebody of substantial proportions. So far the company

VERSATILE BUCYRUS-ERIE STRIPPER WITH THE RIGHT CAPACITY AND REACH

A Bucyrus-Erie 88-B shovel strips overburden at a Minnesota iron mine. The machine is owned by the S. J. Groves Co., Minneapolis.

Whether your stripping operation requires a dragline, stripping shovel or a standard shovel, the Bucyrus-Erie 88-B offers the flexibility to do the job to your satisfaction.

With either of these three front ends, the 88-B puts more than 75 years of Bucyrus-Erie know-how on your job. It is a dependable, *basic* excavator — designed to function efficiently with whichever front end best fits your needs.

The 88-B's big diesel power plant, with your choice of torque converter or direct drive, provides plenty of power for the toughest digging and transmits it with high efficiency through the anti-friction bearings to the point of use. Its smooth, soft air controls permit easy, fast operation while retaining the "feel" of control for the operator.

This outstanding stripping specialist is rated at 2 to 5 cubic yards as a dragline, 3 cubic yards as a stripping shovel and 4 cubic yards as a standard shovel. Take your choice and be secure with the knowledge that your stripper comes equipped with Bucyrus-Erie mining know-how. 369E57

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Bonus Quality Specifications for molding and core sands are rigidly adhered to in the production of castings. Sand compositions must meet close specifications for permeability, moisture content, compression strength, and high-temperature properties. Here, a laboratory technician uses an electronic meter to determine the PH (acid-alkaline ratio) of the sand mixture.

Idaho *(Continued)*

has proved the ore shoot for a length of 500 ft on the main adit level, and for a depth of 230 ft in the winze. A west drift from the 150-ft winze level is continuing in ore after 160 ft of advance.

Triumph Mining Co. early in March announced plans for a complete shutdown of its Triumph Mine in Blaine County near Hailey on Mar. 15, but later reconsidered and decided to continue operations on a sharply curtailed basis. Economic factors were blamed for the move.

Effective Mar. 15, operations were cut back from three shifts to two shifts per day and the 111-man crew was reduced.

The Triumph Mine, as operated since 1940 by Triumph Mining Co., is made up of 160 mining claims, including three early-day producers—the Triumph, Independent and North Star—which have a combined production record of more than $100-million worth of lead, silver, gold and zinc. It is the biggest producer of lead, zinc and silver in Idaho outside the Coeur d'Alene District.

Sidney Mining Co. has advanced its 2300-level east exploration tunnel about 450 ft into easterly-adjoining Nevada-Stewart Mining Co. property and has about 400 ft to go to reach the initial exploration objective, which is the projected intersection of the Brown and McDougall faults where considerable mineralization was found in upper Nevada-Stewart workings. About 1100 ft of additional advance will take the heading to the projected downward extension of the ore shoot which yielded some ore from the Nevada-Stewart tunnel 250 ft below the surface and which was tested by down-hole drilling by the Bureau of Mines back in 1943, with favorable results. The Sidney exploration tunnel is 1400 ft deeper than the old workings on the property.

Bradley Mining Co. in Stibnite, in the primitive area north of Boise, will be completely shut down and the company will sell the mill and smelting equipment, James Bradley, vice president of the company, has announced. The concentrator was sold last year.

The antimony smelter has produced as much as one-third of the total domestic requirements for the metal, according to Bradley. The antimony operation was begun in 1932. The property also was a heavy tungsten producer.

The shutdown of the Stibnite property began in 1952. At one time it appeared a stockpiling policy might permit resumption of full operation. But, Bradley said, "inadequate tariff protection" for domestic antimony finally got the upper hand. Operating costs increased, he said, and ore got lower in grade, and this—coupled with foreign competition—proved too much.

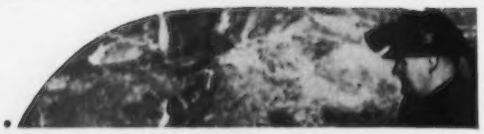
Golconda Lead Mines is now operating its mill 24 hr a day, seven days a week, handling largely custom ore from the Lucky Friday mine, president J. A. Featherstone said at Wallace.

He said the company expects to keep the mill running on an around-the-clock basis for the remainder of the year. Re-elected to the board of directors at the firm's annual meeting were Featherstone, H. F. Magnuson, Wray Featherstone, C. E. Bloom and Walter L. Sly.

ILLINOIS-KENTUCKY

Engineering crews started property surveys in April for construction of a $12- to $15-million uranium hexafluoride plant near Metropolis, Ill., by General Chemical, division of Allied Chemical & Dye Corp. It represents the most recent development in the Ohio River Valley's rapid industrial expansion in the last six years. Actual construction work is scheduled to begin the middle of this month, weather conditions permitting. The site, a 600-acre riverfront tract a mile northwest of Metropolis, is within 50 miles of the Ill.-Ky. fluorspar mining district.

The 5,000-ton green salts refinery will make uranium hexafluoride for the Atomic Energy Commission's gaseous diffusion installations at Paducah, Ky., just across the river; at Oak Ridge, Tenn.; Portsmouth, Ohio; and St. Louis. It will be the first privately-owned plant



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You get ROUND, easy-to-load blast holes, that need not be blown before loading, when you follow this proven drilling technique—(1) drill small holes—(2) use airlegs—(3) with non-rifling Brunner & Lay carbide Rok-Bits® on Brunner & Lay Drill Rods.

For proof of what this accepted 3-step method can mean to you in keeping costs down, output up and your drillers happier—phone, or write, our nearest plant. Small or LARGE hole drilling, we have the bits for them all. Ask for Bulletin B-1.

Carbide Rok-Bits—cross, "X", chisel, cutaway, taper socket bodies—gauge sizes: 1⅛" thru 6".

Intra-Set Drill Steel—carbide insert—gauge sizes: 1⅜" thru 2¼".

Alloy and carbon Drill Steel.

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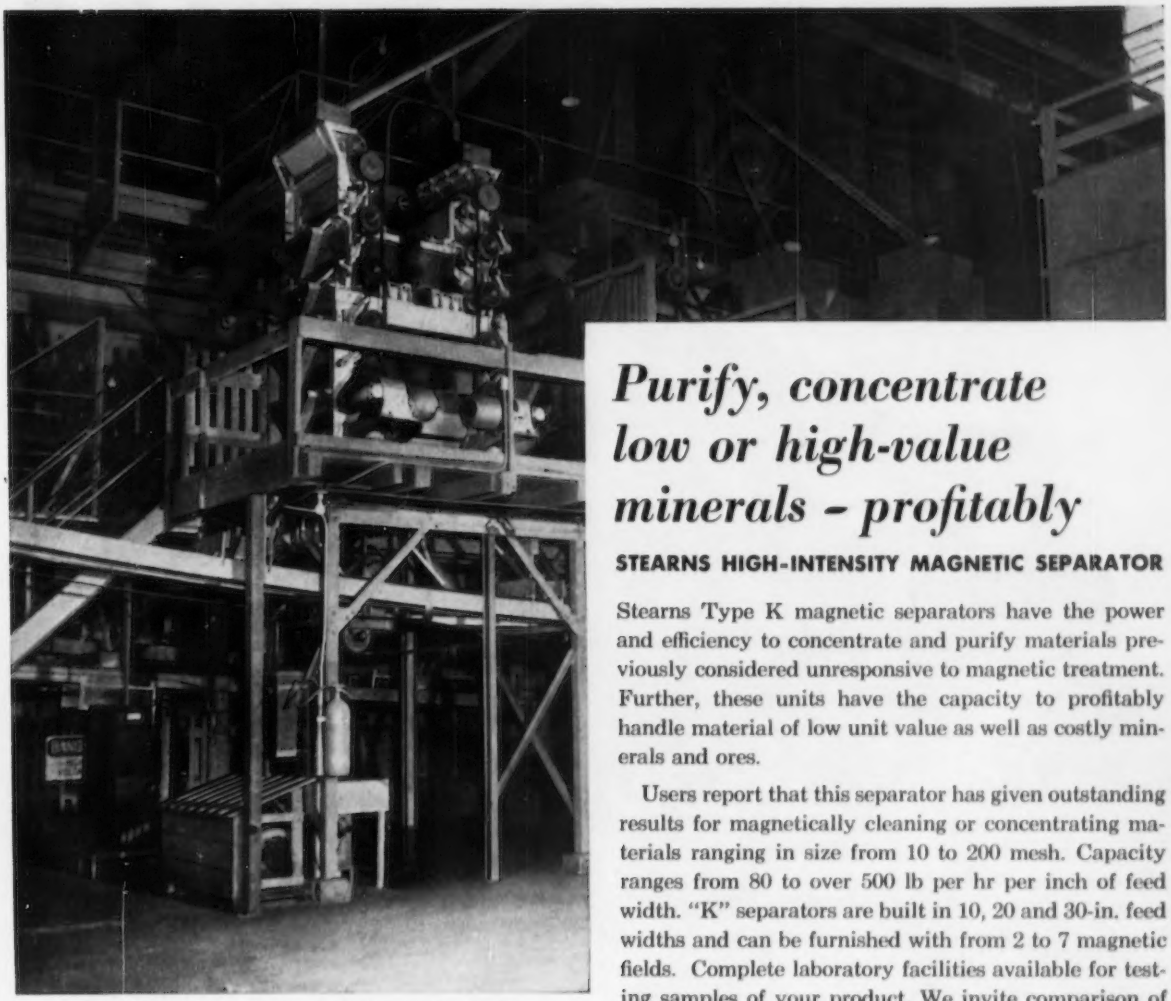

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Purify, concentrate low or high-value minerals - profitably

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Stearns Type K magnetic separators have the power and efficiency to concentrate and purify materials previously considered unresponsive to magnetic treatment. Further, these units have the capacity to profitably handle material of low unit value as well as costly minerals and ores.

Users report that this separator has given outstanding results for magnetically cleaning or concentrating materials ranging in size from 10 to 200 mesh. Capacity ranges from 80 to over 500 lb per hr per inch of feed width. "K" separators are built in 10, 20 and 30-in. feed widths and can be furnished with from 2 to 7 magnetic fields. Complete laboratory facilities available for testing samples of your product. We invite comparison of results. Write today for Bulletin 701-BD.

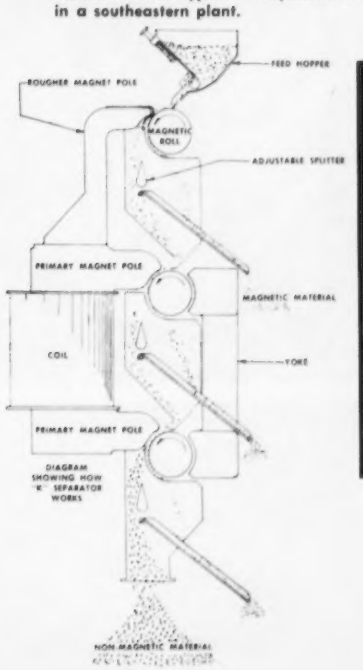

DIAGRAM SHOWING HOW "K" SEPARATOR WORKS

Here are some products the "K" handled profitably:

Product Purification

Silica Sand
Scheelite
Soda Ash
Abrasives
Silicon Carbide
Aluminum Oxide
Pottery Clay
Fire Clay
Kyanite
Nefheline Syenite
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Features that put the "K" out front:

1. Magnetic field protected against flux leakage—Magnet support frame is not part of magnetic circuit. Specially constructed steel rolls with non-magnetic stub shafts further insulate magnetic circuit.

2. Simple adjustment—Positive, easy control of feed rate, air gap width, splitter settings for extremely accurate separation. So simple, unskilled workers can operate and adjust it.

3. Uniform material distribution — Louver-type feeder provides uniform distribution across entire feeder width. Effective use is made of all available feed width.

4. Powerful magnetic force — Primary pole noses are scientifically shaped to give maximum flux density in separating zone — take full advantage of available magnetic flux.

5. Progressive inductive magnetization provides greater efficiency—Successive magnetic fields induce magnetic properties even in materials having low responsiveness to magnetic force.

31

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WEIGHS 3½ TONS LESS

TRAVELS FASTER

CARRIES MORE PAYLOAD

ADDED! POUNDS SAVED!

High strength-to-weight ratio of USS "T-1" Steel solves difficult design problem

In the past, lightweight materials such as bauxite ore have presented a hauling problem *because* of their light weight. Standard hauling units, designed for heavier materials, had too much dead weight . . . couldn't haul enough volume of lightweight materials. Athey Products Corporation, Chicago, Illinois, has solved the problem with the help of USS "T-1" Steel.

Athey engineers designed a new rear-dump trailer specifically for high-volume lightweight materials. Starting point was a conventional 22.5-cu.-yd. trailer. The high yield strength of USS "T-1" Steel—90,000 psi minimum—enabled them to use much higher design stresses and, thus, reduce the thickness of steel required.

As a result, volumetric capacity of the 22½-cu.-yd. model was boosted to 30½ cu. yds. The new unit weighs just 13 tons—7,000 pounds less than it would if built with low-alloy steel. USS "T-1" Steel's toughness and resistance to impact abrasion give the trailer ruggedness and durability needed in off-road mountain service.

This lighter-weight trailer can travel much faster, when empty, than heavier standard units. As a result, it spends less non-productive time in making empty return trips to the mine. It not only carries more payload, but is hauling payload during more of its total operating time.

Where can you use USS "T-1" Steel?

Consider USS "T-1" Steel where you need an unusually high strength-to-weight ratio. Use it where you need unusual toughness and resistance to impact abrasion at low temperatures . . . where you need good high-temperature strength combined with toughness and resistance to abrasion. Remember, *all* of these properties are combined in USS "T-1" Steel *with good weldability*. Call, wire or write for more information. United States Steel, Pittsburgh 30, Pa.

SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

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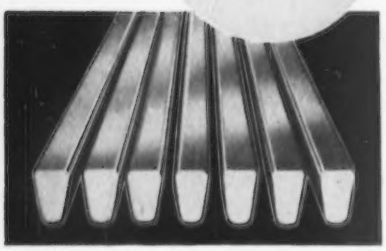

WEDGE-WIRE profile F217 - .312 high, .187 wide
F250 - .375 high, .191 wide

Especially designed for extended life in abrasive applications. Possesses the necessary construction features to easily maintain openings from ½ inch to as close as 1 m.m. Available in many metals. Furnished in guard bars and special shapes or designs. Adaptable to vibrator applications.

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*INDEPENDENT FLEXING ACTION—Unique construction permits individual wires to "flex" independently for greater screening capacities and abilities while maintaining "rigid" requirements.

write for prices and details

WEDGE-WIRE CORPORATION
Wellington, Ohio

CONCRETE WORK for the sampling plant, ore bins and mill building at Union Carbide Nuclear's $1.5-million concentrator site at Slick Rock area.

Union Carbide Concentrator Due in August

ONE OF TWO NEW CONCENTRATORS being built by Union Carbide Nuclear Co. to feed the new 1,000-tpd mill at Rifle, Colo., is now under construction in the Slick Rock area of San Miguel County, Colo. The concentrator, which is to be completed in mid-August, will join with a similar plant of somewhat smaller capacity now under construction at Green River, Utah, to feed the larger mill. Both plants will use an acid-leach process developed by Union Carbide.

Catalytic Construction Co. of Philadelphia, Pa., is prime contractor for the project, on which about 90 workers were employed at the end of March. Charles Bossart, construction superintendent for Catalytic, said peak payroll this summer will be around 350 men.

Since the Dolores River flow diminishes to a trickle—and sometimes vanishes entirely—during dry summers, a well has been sunk in the river bottom to supply water for both mill and domestic use. The present well pumps a maximum of 225 gpm, and a second will be dug if necessary. A cavern is being blasted out of the Entrada rim above the camp to serve as a 300,000-gal underground storage reservoir, to which water will be pumped through a pipeline from the river bottom well. Power is supplied by the San Miguel REA co-op.

Concentrator facilities will include office and warehouse buildings, ore bins, a sampling plant, mill building and acid-leach building. Concrete work on ore bins, sampling plant and mill was underway when site was visited in late March, and location for the acid-leach building had been staked. Steel for the structures had arrived in Grand Junction, Colo., by rail and will be trucked to the plant site.

Construction necessary to the project will include a new bridge across the Dolores and a new access road. An air strip at the site has been in use for some months.

The concentrator will be fed both by Union Carbide mines and ore bought from independent producers in the vicinity, it is understood. Only other concentrator now in operation on the Plateau is that of Vanadium Corp. of America at VCA's Monument No. 2 mine in northeastern Arizona, which uses a sand-slime process to upgrade ore of less than 0.10% U_3O_8.

Ill.-Ky. *(Continued)*

to produce uranium hexafluoride, which heretofore has been made only in Government-owned facilities.

Construction is expected to require two years with approximately 700 workers employed while an estimated 400 will be permanently employed in operation.

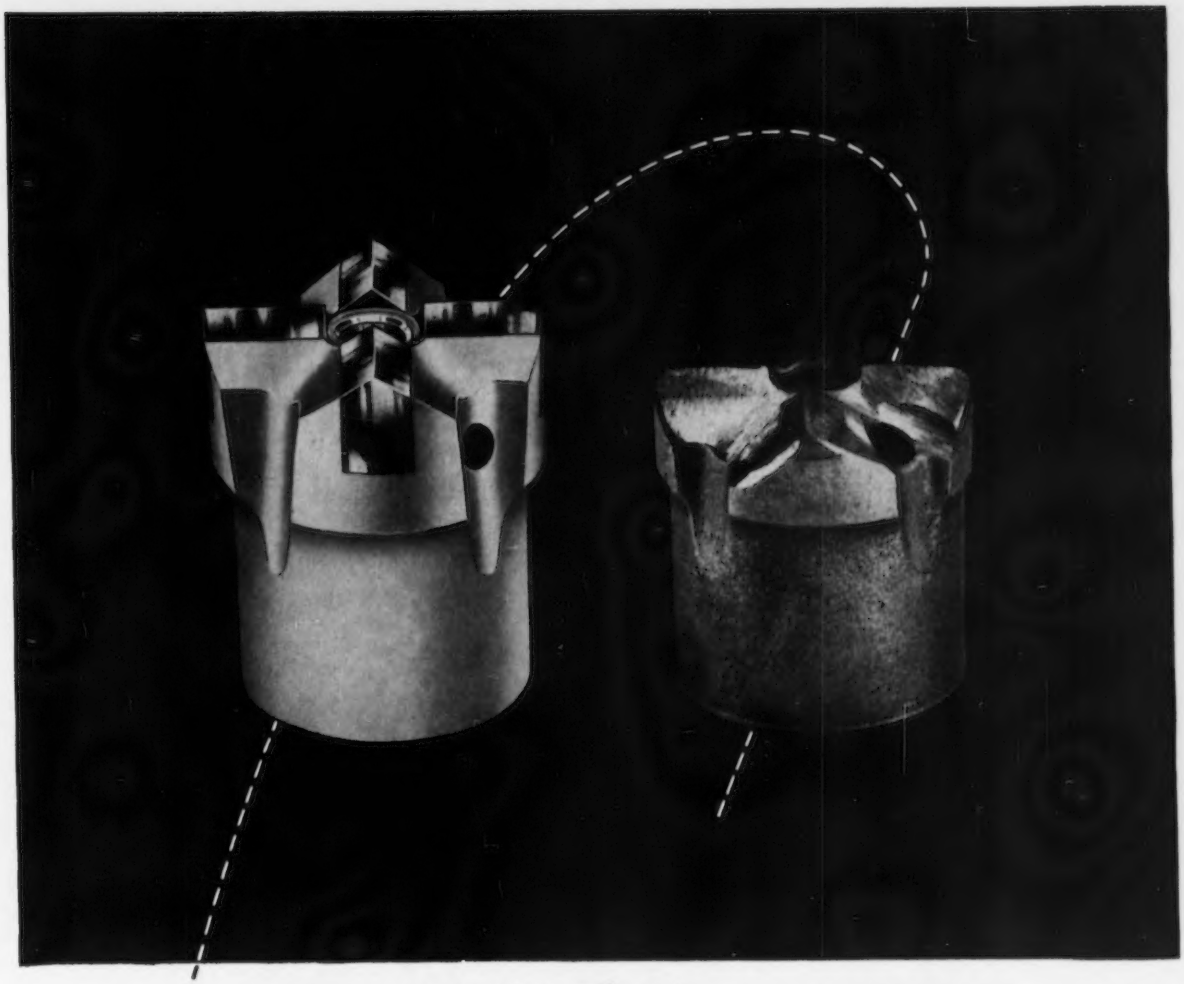
The Metropolis installation will utilize an Allied developed process of distillation, a method differing from that employed by the AEC, in making the refined uranium hexafluoride from crude concentrates provided by the AEC.

Accessibility to the Illinois Central and the Chicago, Burlington, and Quincy railroads, available power, abundant water supply, a site above flood danger, and a surplus labor pool in southern Illinois were among determinant factors in selection of the site. Power will be furnished by Central Illinois Public Service Co.

Official announcement of the project said the Metropolis plant also is scheduled to become a production center for other fluorine chemicals.

"Allied Chemical," it was announced, "foresees the development of other products and services at the Metropolis installation as the AEC program accelerates and broader uses of atomic energy evolve in the non-military field of application."

Aluminum Co. of America has made no definite decision at this time as to construction of a smelter and power plant in western Kentucky, but has acquired options to 12,000 acres of land in Crittenden and Union Counties, lying along the Ohio and the Tradewater Rivers as a possible site for such future development in accordance with the company's



THIS JOY BIT DRILLED *46% Farther*... STILL MORE TO GO

YOU'LL FIND YOUR BIT SIZE IN THIS CHART

SHOULDER DRIVE	BOTTOM DRIVE	TAPER SOCKET
1½"		1¼"
1⅝"		1⅜"
1¾"		1½"
1⅞"		1⅝"
2"		
2⅛"	2½"	Note: Shaded areas are X-Type, others are Cross Type
2¼"	2¾"	
2⅜"	3"	
2½"	3¼"	
2¾"	3½"	
3"	4"	
3½"	4½"	
4"	5"	
4½"	5½"	
	6"	

WRITE FOR FREE BULLETIN 172-4

Drilling Rock with a scleroscope hardness of 90-100 takes a lot out of most carbide bits . . . on this job, other bits were averaging 532 feet. Our illustration shows a Joy bit before and after drilling almost 800 feet in this formation. The average for Joy bits on the entire job was 781 feet.

Here's why: OFFSET WINGS allow drag-free rotation, faster removal of cuttings, easy reconditioning . . . DEEP SLOTTED CHIP WAYS allow cuttings to escape; bit does not regrind its own cuttings . . . INSERT STAYS IN because of new brazing method . . . SPECIAL ALLOY STEEL BODIES heat treated for shock resistance and high fatigue life . . . PRECISION MILLED THREADS instead of tapped threads.

These are the reasons why Joy tungsten carbide bits give extra footage . . . and only Joy bits have all these features. Let your Joy representative prove it to you. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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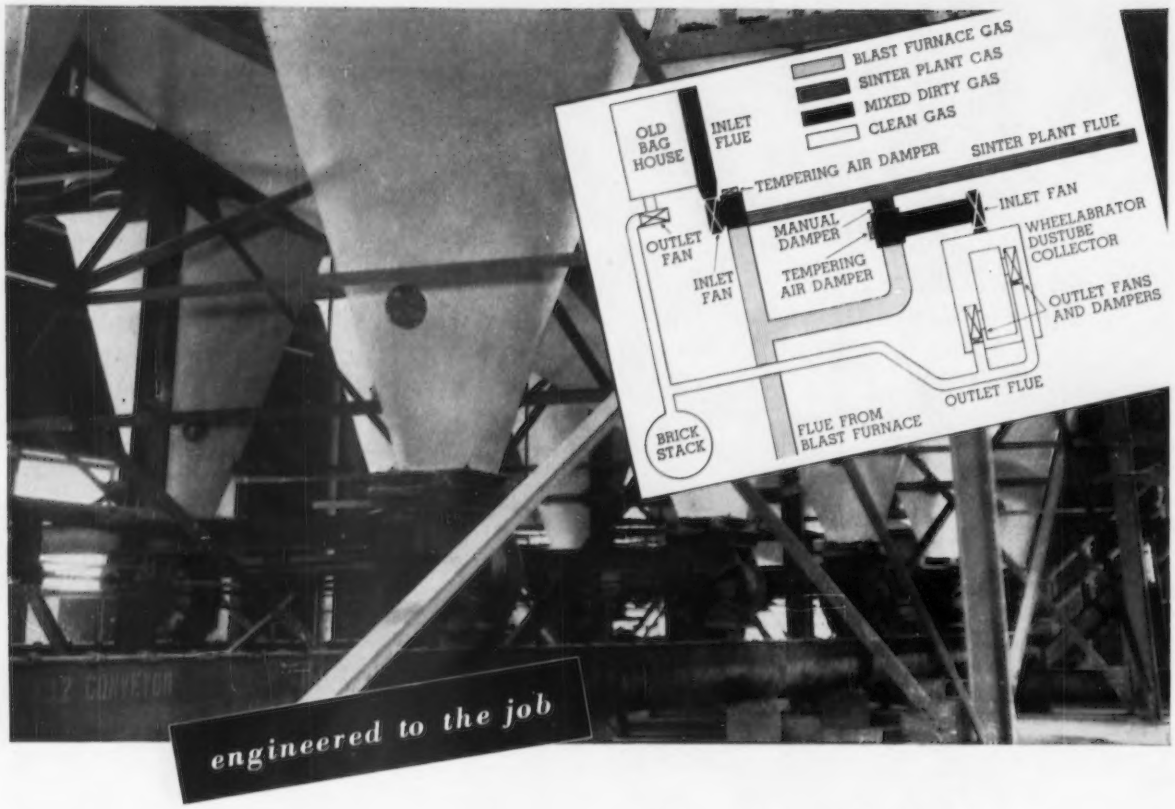
Wagon Drills

Drilling Bits

Hand-Held Rock Drills



WHEELABRATOR® DUSTUBE® Collector

eliminates air pollution — cleans flue gas

Increase in sintering capacity, at a prominent lead smelter, necessitated an addition to the standard baghouse collection system for the filtering of flue gas from sintering machines and blast furnaces . . . and the salvage of this valuable material.

After visits to other smelters and checking on many systems, plant officials chose a Continuous Automatic Wheelabrator Dustube collector with Orlon fabric filter tubes.

The collector installed is a 12-compartment, continuous operation model. While tubes in 11 compartments are filtering, those in the 12th are shaken to drop collected material into screw conveyors for return to the sintering plant. Each succeeding compartment is automatically shaken in turn.

The Wheelabrator Collector was engineered into the existing system and no additional operating personnel was required. Capacity was rated at 136,000 cfm. Volumes handled have been as high as 150,000 cfm. Much improved smoke conditions have been maintained at the blast furnaces and in the plant generally and valuable material has been reclaimed. The Orlon tubes have shown no wear in a year.

To better working conditions, increase material recovery and assure a clean stack in your plant, investigate the high efficiency of Wheelabrator cloth filter systems.

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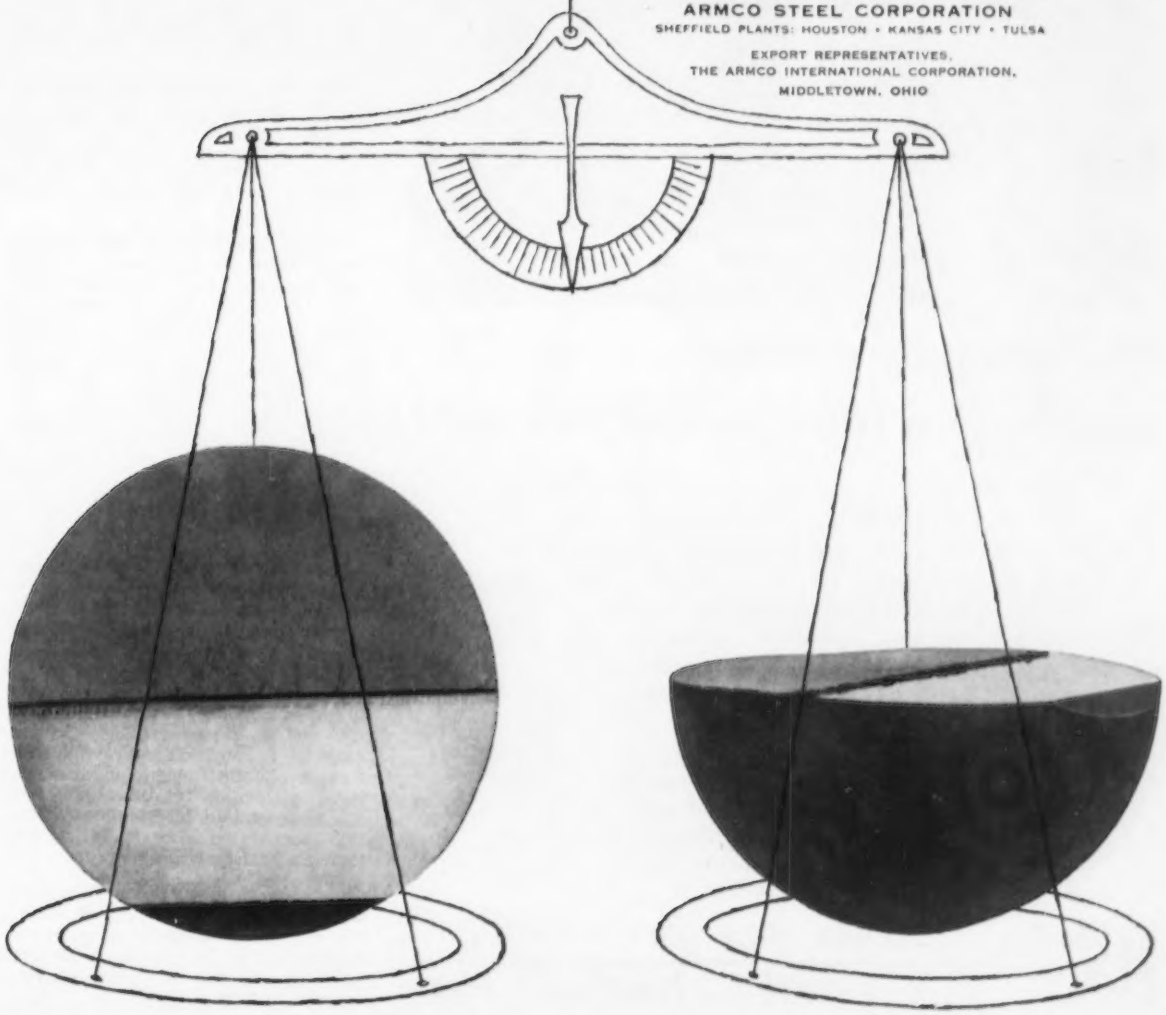
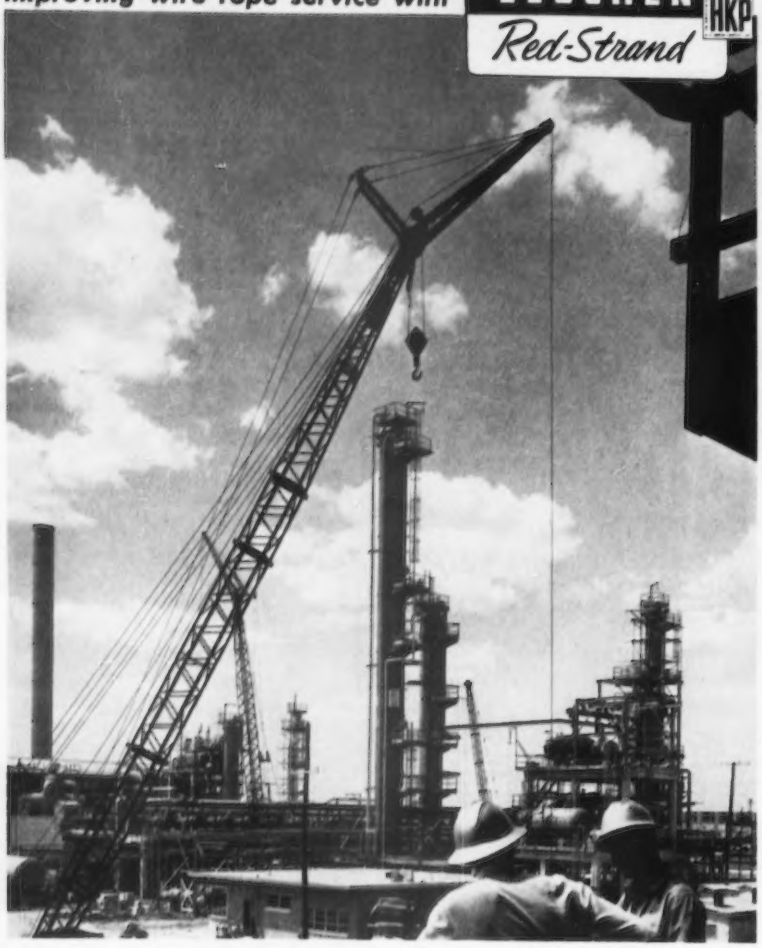


Improving wire rope service with LESCHEN HKP *Red-Strand*



This one test proves which wire rope serves you best

"Problem jobs" may frequently make you wonder about the rope you're using.

Are you faced with unusual operating conditions? Is the rope the right type—size—grade—construction? Is greater tensile strength needed? Are you using the right brand?

The test is to use Leschen's on-the-job Service-Score Sticker reports. Keep the score—know the results—and questions are answered.

Then check with your Leschen man for engineering help. And, be sure to use Leschen's highest quality, service-proved Red-Strand wire rope. *Leschen Wire Rope Division, H. K. Porter Company, Inc., St. Louis 12, Mo.*

Write for Service-Score Fact-Folder

HKP LESCHEN WIRE ROPE DIVISION
H. K. PORTER COMPANY, INC.

Ill.-Ky. *(Continued)*

long-range plans. Options also were obtained on all surface, mineral and coal rights of the Mid-Continent Coal & Coke Co., formerly properties of the Old Bell Mines, to assure additional fuel reserves.

MICHIGAN

Unwatering and repairing of Calumet & Hecla's Osceola mine No. 6 shaft has progressed to below the 43 level. The mine was closed in 1931 and allowed to fill with water. Estimated amount of water in the mine was about 9-billion gal. Mining at the Osceola No. 13 shaft was resumed in 1955.

Another mine added to the lengthening list of exhausted properties is the Anvil-Palms between Ironwood and Bessemer on the Gogebic Range. Last production was on Jan. 31 of this year; 1956 shipments: 489,956 tons. The mines made their first shipments in 1887. Palms shaft was abandoned for hoisting in 1951. Since that time the ore was hoisted through the Eureka shaft of the Castile Mining Co.—Oglebay, Norton & Co. agents. Pickands Mather & Co. operated the Anvil-Palms for Youngstown Mines.

Inland Steel Co.'s Sherwood mine loaded the first ore from shaft pocket in the Iron River area Mar. 24. The company's Bristol mine at Crystal Falls followed on the 26. Ore from both mines was scheduled to be loaded in the steamer L. E. Block Apr. 2.

Michigan Section of the Lake Superior Mines Safety Council met at Caspian Apr. 4. Among general interesting papers presented were: "The Importance of Color in Safety" by Irwin L. Karlstad of the Pittsburgh Plate Glass Co.; "An Editor's Viewpoint of Safety" by David N. Skillings, Duluth, of *Skillings' Mining Review* and "Safety Incentive" by Edward Leonard, Ishpeming, of Cleveland-Cliffs Iron Co.

MINNESOTA

Jones & Laughlin Steel Corp.'s Minnesota Ore Division carried on a heavy stripping program at its Schley pit at Gilbert during the past winter in anticipation of an active shipping season for 1957. J&L made its first shipment from the Schley (a former Republic Steel Corp. underground mine) in 1951. In 1956 the mine produced 215,133 tons.

Jones & Laughlin's new spiral and flotation plant at Calumet, to treat tailings from the big Hill-Annex mine tailings pond, will be in operation for the 1957 season's opening. Work on the plant was begun last summer.

Oliver Iron Mining Division's eastern district has given the village of Mountain Iron a new automatic water pumping plant valued at $35,000. It has two wells, 60 ft deep, and two 340-gpm. automatic pumps.

Minnesota (*Continued*)

Oliver Division has completed mining at its Mountain Iron open pit mine-one of the earliest operations on the Mesabi Range. It was opened by the Mountain Iron Co. in 1892 and operated by them, Lake Superior Consolidated Iron Mines and Oliver Iron Mining Co. until 1908.

Arrowhead Section of the American Institute of Electrical Engineers met in Duluth Mar. 8. Albin A. Rutkowski, products engineer with the Harnischfeger Corp., Milwaukee, was the speaker on the subject: "Electric Crane and Shovel Control."

A bill has been introduced in the Minnesota state legislature extending existing taconite leases on state lands from the present 50 years for an additional 25 years. Spokesmen for Erie Mining Co. have urged the passage of such a bill. They maintain that the huge investment required to build taconite plants such as those of Erie Mining Co., Reserve Mining Co. and that contemplated by Oliver Iron Mining Division cannot be justified for the 34 to 39 years remaining of original 50-year taconite leases.

Failure to provide longer leases, they say, would hinder further expansion of present plants and the building of new ones.

The large screening and sizing plant which has been under construction at Oliver Iron Mining Division's Rouchleau mine near Virginia will be ready this spring. It will treat direct shipping ores for the Rouchleau, Auburn and Sauntry mines. Most of the screened out fines will be shipped to U.S. Steel's sintering plant at Gary, Ind. A similar plant is being constructed at Chisholm for the mines in that area.

The M. A. Hanna Co. big dragline and equipment, which has worked at the South Agnew and Morton Mines for some years, is now being moved to North Hibbing. It will be used for stripping the property released by the agreement with the Village of Hibbing which was concluded recently. Because of the machine's great weight it is necessary to cross low and swampy ground while it is still solidly frozen.

Oliver Iron Mining Division, too, is making preparations to begin work on their North Hibbing property.

MONTANA

Eighth annual field conference of the Billings Geological Society will be held in September in the Crazy Mountains Basin of south central Montana.

Registration will be Sept. 5, in Livingston, with the field conference starting the following morning. A banquet will be held in Livingston Sept. 6, followed by a program to be announced. The field trip will be concluded on Sept. 7.

The purpose of the conference is to study the stratigraphy, basin and mountain structure of the Crazy Mountain Basin, in the area from Big Timber

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Rugged, non-twisting AIR HOSE?
Though lightweight for easy handling, this hose won't snake or twist under pressure. It takes dragging . . . resists oil damage . . . withstands cracking at temperatures as low as 20°F. Tough Neoprene cover withstands all weather conditions.

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This all-purpose water hose is long on wear and value. Easy to handle, it has a black, high-grade rubber cover that resists sun, weather, cracking and peeling. Black, non-porous tube.

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Here's a rugged, long-lasting hose for conducting water under pressure or suction. It resists kinking and crushing and has good sun, weather and abrasive-resistant qualities. Tube resists action of water containing light concentrations of alkalies, acids, grit and sand.

THESE are but a few of the many types of air, water and suction hose your Quaker-Quaker Pioneer distributor has on hand and ready to go. Call him—whatever your needs. For free brochures, write: *H. K. Porter Company, Inc., Quaker Rubber Division, Phila. 24, Pa., or Pittsburg, Calif.*

HKP QUAKER RUBBER DIVISION
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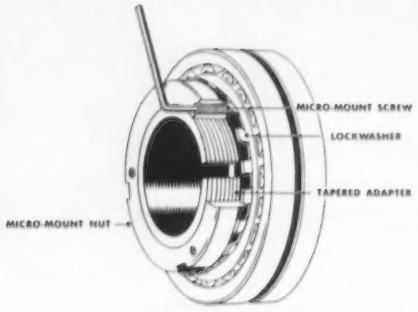
Exclusive MICRO-MOUNT



Fast and accurate mounting is made possible by the new Dodge Micro-Mount. The Adapter is snugged up with the Micro-Mount Nut. Mounting is completed by turning the Micro-Mount Screws against the Lockwasher until bearing, adapter and shaft form an integral unit.

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SPHERICAL ROLLER BEARING PILLOW BLOCK

Dodge, the nation's leading supplier of mounted bearings, presents America's newest spherical roller bearing pillow block . . . a rugged bearing in attractive modern design . . . inherently self-aligning . . . easy to install . . . easy to maintain . . . and featuring the unique Micro-Mount.

Its rugged housing of close-grained semisteel withstands shock loads. It has a generous lubrication reservoir—for oil or grease. And standardized dimensions make Spher-Align interchangeable with all other similar units.

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CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new methods. Look for his name under "Power Transmission Machinery" in the yellow pages of your classified telephone directory—or write us.

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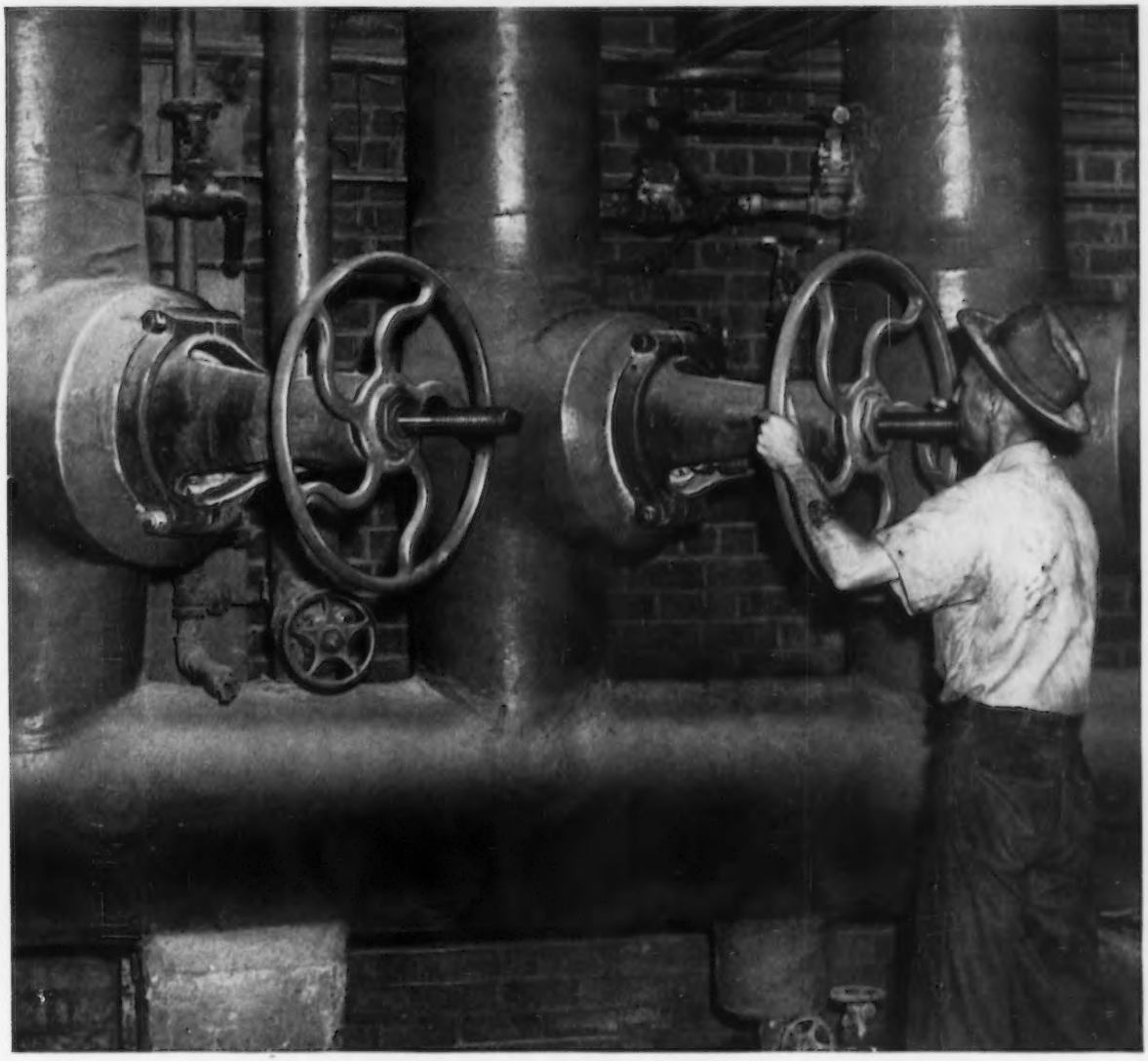

These valves helped the maintenance crew win a losing battle

This process industry plant saw the danger signal. Servicing leaky valve bonnet joints was taking too much time. Other important maintenance work was being neglected.

That's why, in 1947, when expanding the power plant, Crane Pressure-Seal Bonnet Gates were chosen for main steam service as shown above. Working pressure: 600 psi at 725 deg. F.

These Crane valves need no bonnet joint maintenance. The joint is leakproof—sealed tight by internal fluid pressure. Crane alloy seats and flexible wedge disc make closure tight and easy.

To date, the Crane Pressure-Seal Gates have given this plant over 9 years' uninterrupted service. The maintenance crew hasn't touched them except for routine care.

Full information on these modern power service valves is given in Circular AD-1936. Get a copy from your Crane Representative or by writing to address below.

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PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

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Montana *(Continued)*

north to the Castle Mountains, south of White Sulphur Springs.

NEVADA

Kennametal, Inc., of Latrobe, Pa., has announced plans to construct a tungsten carbide plant at its Nevada Scheelite mine site in Mineral County 40 miles northeast of Hawthorne. Two high tension generators will be used for creating the heat necessary for manufacture of tungsten carbide, and negotiations are under way with the Mineral County Power Co. to build a line to the plant site and furnish the electric power. Ernest Colwell, mine and mill manager at Nevada Scheelite says only a small crew will be required at the plant following the initial installation. He said the generators, one 100 kw and one 200 kw, will be operated by the diesel electric plant at the mine until cheaper power is obtained from Hawthorne. The Nevada Scheelite mine and mill, which had been one of Nevada's major tungsten producers during 1956, shut down operations in February, when the Federal subsidy was denied. The payroll during last year was 160 men.

Nevada Highway Department has awarded a contract to build 27.3 miles of highway between Gold Acres, Nevada's only strictly gold producing mine, and Beowawe, railroad loading point, in Eureka County. Gold Acres, which is situated in Lander County, is operated by London Extension Mining Co., and has been a paying gold and silver producer for more than 20 years.

The recently reconstructed mill at Goldfield, owned by the Monarch Mill & Mining Co., was given a successful test run during March. The work was done on 300 tons of cinnabar ore from the Argentite Mine situated 25 miles from Silver Peak and about 50 miles from the mill. J. H. Fawcett, general manager of the Monarch Co., came from his offices in Las Vegas to witness the tests and said the results were satisfactory.

Workers in Kennecott Copper Corp.'s underground department at Ruth completed an all-time division record for safe working practices during March, according to Dale J. Brown, safety director. As of Mar. 6 a total of 342 men in the department had worked 126 days for a total of a quarter of a million man-hours without a lost-time accident.

Cutback in Federal subsidies resulted in the lay-off of 25 miners at the Getchell tungsten mine in Humboldt County during March. A former gold producing property, Getchell has been mining and milling tungsten for the last several years, and is one of the nation's large producers of that metal.

Consolidated Eureka Mining Co., Salt Lake City, has lifted monthly output of lead-gold-silver ore from its Diamond mine in Nevada's Eureka district to 411 tons according to James E. Hogle, president.

At this time last year, output was running at rate of 10 tpd, or 300 tpm. Shipments are made to the Midvale, Utah, smelter of U. S. Smelting, Refining & Mining Co., Mr. Hogle said.

Al Carrey, newly appointed manager of the Rundberg mine near Austin, has been sampling ore preparatory to making a final report. This will be followed by application to the AEC for permit to build a mill for treatment of uranium ore. Plans for the mill are being prepared by Albert Silver, of Western Knapp Engineering Co., San Francisco. Rundberg mine is operated by Apex Minerals Corp., and Hugh Cameron has been appointed consultant.

Plans are now under way to reopen the famed Mogul mines of Alpine County, California, 73 miles southeast of Reno, according to a statement made by J. M. Tyler, general manager of the Alpine Eureka Mining Corp., which is planning a redevelopment project at the once profitable property.

A thorough geological study is now being made, he said, and the future program may develop into another major western mining operation for pit ore extraction, with a large mill and reduction plant for ore beneficiation.

Here is what you get when you use the improved KENNAMETAL* STYLE PX Rock Bits

Kennametal Style PX Rock Bits are available in sizes from 2½" to 5" diameter.

Improved "X" design eliminates rifling, provides greater chip clearance and promotes faster penetration. Alternate long and short carbide insert design puts the carbide where it is needed most, and also speeds penetration. Two off center water ports improve the removal of cuttings.

Longer bit life in service is provided by three new design features: First, these bits generally have more carbide than other bits of equal size. Second, the long inserts are segmented for greater strength. Third, all inserts are of special grades of carbide that were developed specifically for percussion drilling.

This new design eliminates the center spacer, a common source of trouble in drilling operations.

Investigate these bits for your drilling problems. A Kennametal representative will help you select the size and grade of Kennametal Rock Bits for each of your operations. Call him or write KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania.

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Prospecting. The Universal 'Jeep' is a workhorse in all types of prospecting operations. It travels the highway in conventional 2-wheel drive at top legal speeds. Then, for rough going—through mud, sand, soft earth, over rocky terrain or up 65% grades—it shifts easily into 4-wheel drive for the all-wheel traction that takes men and equipment "anywhere-anytime."

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New Forward Control 'Jeep' FC-150. This advanced 4-wheel drive truck puts a 74" pickup box on a wheelbase only 81" long. It's the first time a 4-wheel drive truck has combined so much cargo area with such unusual maneuverability.

'Jeep' vehicles get through when ordinary vehicles bog down in the heavy rough going of mining projects. Their rugged "go-anywhere" ability makes them ideal for use in every phase of the mining industry—from exploring or prospecting in remote areas to keeping maintenance work and service around the mine moving on schedule.

'Jeep' vehicles are the only 4-wheel drive vehicles in their weight class time-tested and performance-proved in billions of miles of transport service. They're the only vehicles originally designed and engineered completely for 4-wheel drive off-the-road use. They work for you 365 days a year. The extra traction of their 4-wheel drive takes them up steep inclines or over rocky ledges—anywhere you need to go! And they tow heavily-loaded ore trailers on or off the road—in good weather or bad.

Versatile 'Jeep' vehicles spread their costs over a wide variety of jobs... provide additional savings through long life, low upkeep and high resale value. Ask your Willys dealer for an on-the-job demonstration, or write for information.

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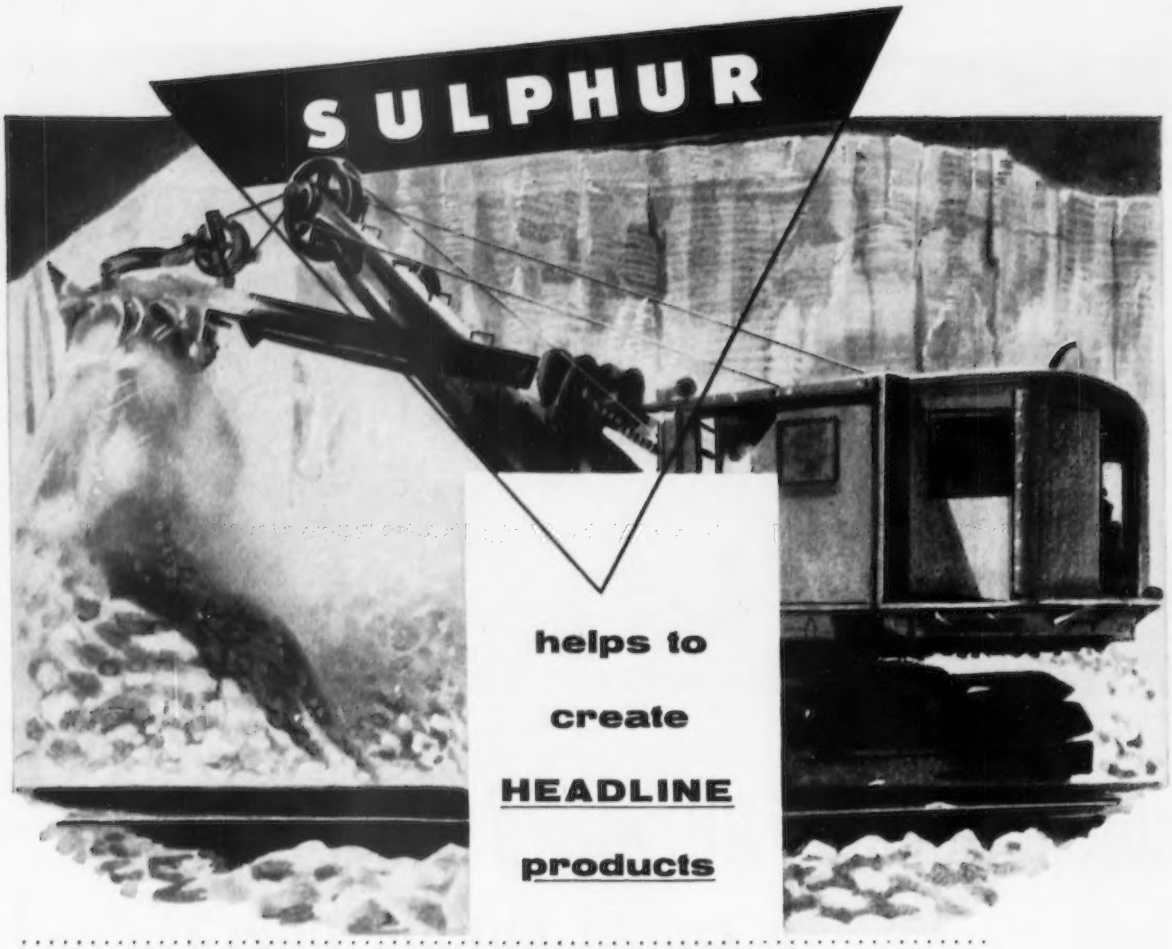
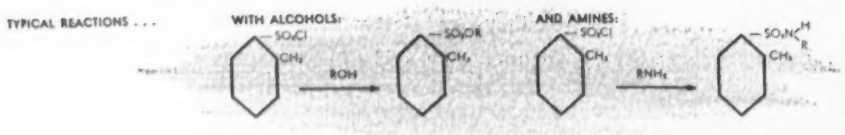


o-TOLUENESULFONYL CHLORIDE*



Industry has a new working tool in o-Toluenesulfonyl Chloride. This 98% pure ortho isomer can be used in building molecules for use in a wide variety of new products, from dyestuffs to pharmaceuticals; from plasticizers to herbicides. It is even possible that it is now being used in products you are making or have recently acquired.

From the chemical name of o-Toluenesulfonyl Chloride it is obvious that sulphur is a component of this compound . . . added evidence of the important role Sulphur plays in our industrial economy.

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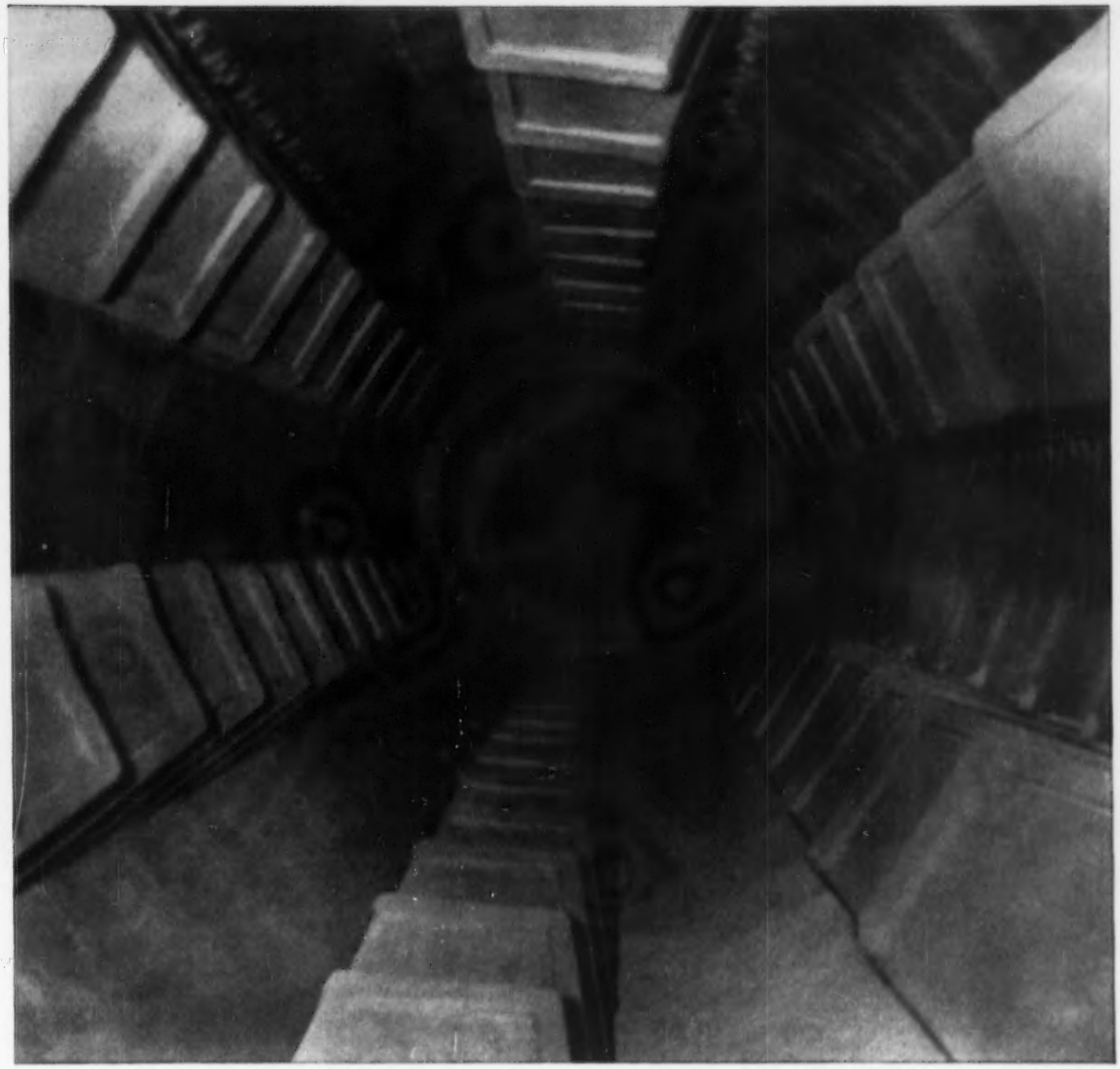

Carbon steel formerly used in this Simplicity aggregate drier wore out from smashing impact after handling 1¼ million tons of crushed dolomite but life expectancy is now over 4 million tons. Drier operates in one of the plants of The J. E. Baker Co.

Lukens "T-1" steel triples life of rock drier

TRADEMARK

Are impact and abrasion shortening the life and rocketing the costs of your equipment? If so, there's a lesson here for you:

When the liner shell and partition plates of this 10 x 20 foot Simplicity aggregate drier were replaced with Lukens "T-1" steel, life expectancy increased threefold!

Whether you handle stone, coal, or metal ores, it will pay you to investigate Lukens "T-1" steel for surfaces hard-hit by impact and abrasion. The 321 minimum Brinell quality has been known to outlast ordinary steels by 18 to 1. Applications are many throughout the materials handling and processing industries. Wear plates, chutes, hoppers, and mine cars are typical.

The remarkable combination of hardness and toughness in this high yield strength, readily welded alloy steel is even maintained at temperatures well below zero. *Send for informative illustrated booklet, "Lukens 'T-1' Steel." Write Manager, Marketing Service, Room 901, Lukens Steel Company, Coatesville, Pennsylvania.*

LUKENS ®

Helping industry choose steels that fit the job

Nevada (*Continued*)

American Colloid Co., of Chicago, has bought seven barite mining claims in Elko County for a reported price of $35,000. Sale was made by Herb Butler, of Dry Creek, and Martin Saunders, of Elko, who discovered the site while scouting for deer camps last spring. The property, known as the Jungo claims, lies 50 miles north of Wells, and during the last seven months the owners have carried out an extensive exploration program under direction of Jack Johnson, of Tulsa. Pocahontas Core Drilling Co., of New Mexico conducted diamond and core drilling during that period and found ore with a specific gravity of 4.20. A new road 24 ft wide and 4 miles long has been constructed to the site by the Hunt Construction Co., of Elko. The Chicago firm took a lease with option to buy on July 1, 1956, and completed the purchase in early March.

NEW MEXICO

U. S. Atomic Energy Commission announced that after May 1, 1957, it would discontinue the practice of paying for the vanadium content of non-carnotite ores at the Grants Government-operated buying station. No change will be made in the schedule for carnotite-type ores, and the producers of such ores will continue to receive payment for the vanadium content as provided in Circular 5, revised.

Kennecott Copper Corp. will spend more than $6-million on major equipment items at its New Mexico operations during 1957, according to W. H. Goodrich, general manager of the company's Chino Mines Division in southwestern New Mexico.

Nearly $3-million will be spent to enlarge the company's power generating capacity at its Hurley, N. M., plant; more than $1.5-million will go for additional rail equipment in the Santa Rita open pit copper mine; other expenditures will provide equipment at the Hurley concentrator and additional shop space at Santa Rita.

A new 16,500-kw steam turbine generator will be added to the power plant facilities at Hurley, not only increasing power supply, but also replacing some older items of equipment in a few years. Goodrich said the entire project will be completed in two to three years.

Two new 125-ton electric locomotive and 41 railroad cars for waste haulage will be acquired during the year. Some of the cars will replace older ones, while others will be used to increase haulage efficiency. Goodrich said increased depth in the mine and greater height in the dump areas have made the new equipment necessary.

A new power shovel of 8-cu yd capacity and costing more than $250,000 will be ordered. It will be larger than any now used in the pit.

More than a $250,000 will be spent at the Hurley concentrator on new equipment, including a new crusher at the lime plant. Other expenditures will be for additions to the truck fleet.

Atlas Corp., headed by financier Floyd Odlum, announced in March it has purchased stock control of Rio de Oro Uranium Mines, Inc., which owns two major Ambrosia Lake orebodies.

As result of the transaction, Hidden Splendor Mining Co., Atlas subsidiary, will take over operation of Rio de Oro properties. W. Rodney DeVilliers will continue as president of Rio de Oro, the announcement said.

Rio de Oro is the only firm now mining in the Ambrosia Lake area, and has shipped approximately 20,000 tons of ore. The company is associated with Homestake Mining Co. in Homestake-New Mexico Partners, which was scheduled to break ground Mar. 30 for a new 750-tpd uranium processing mill.

Proposal for a 1,500-tpd uranium processing mill in Ambrosia Lake area has been submitted by Phillips Petroleum Co. to AEC's Grand Junction Operations Office, it was disclosed Mar. 26.

Two other proposals for Ambrosia Lake mills are being considered by AEC, and ground was scheduled to be broken Mar. 30 for the Homestake-New Mexico Partners plant which already has been approved. A proposal also has been made for a mill at Los Lunas.

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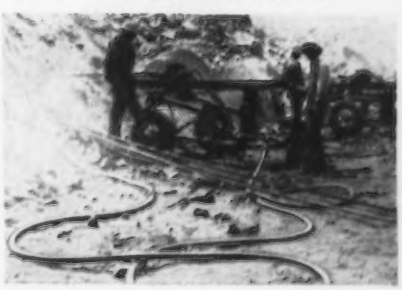

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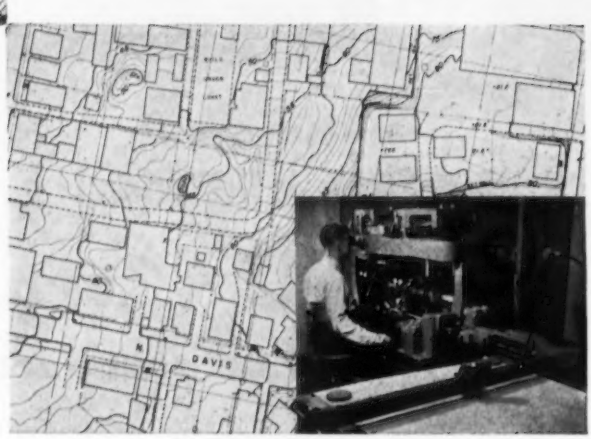

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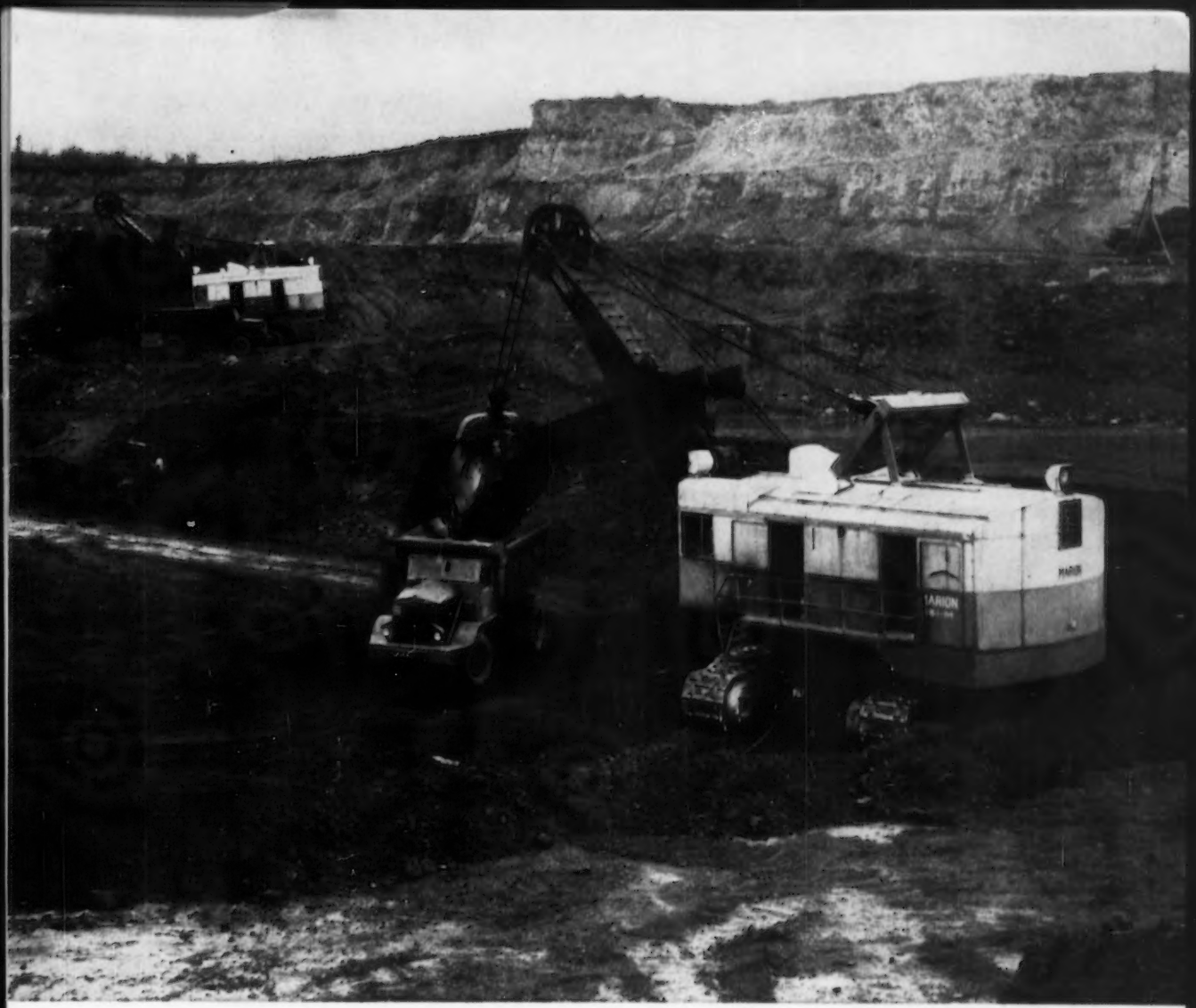

Marions Teamed For Steady Big Production

Two Marion 151-M shovels are hard workers in this area of Minnesota's rich iron ore country. The team of machines operates 16 hours a day, 6 days a week, stripping overburden composed of glacial drift, Virginia slate and taconite.

There's a machine in the Marion line that is just right for smaller digging jobs, too. Shown above is the 35-M, a speedy hard-working ¾-yard shovel, which has the same kind of stamina as its big brothers.

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DIAMOND DRILLS work through the ice on Bernic Lake near the headframe of Montgary Explorations Ltd., where firm has some 8-million tons estimated.

Montgary Explorations Plans Lithium Mine

WITH THE THROWING OF A SWITCH to bring power to the mine of Montgary Explorations Ltd.'s headframe and property at Bernic Lake, Manitoba, the company surged ahead with the sinking of a 650-ft, three-compartment shaft and eventual mining of more than 1,000 tpd spodumene ore to feed a concentrator which will produce a concentrate of 5.5 to 5.9% Li_2O. Shaft is to be completed this month.

Based on 27,000 ft of drilling, Montgary claims some 8-million tons of 1.85% ore. The top of the orebody is at 325 ft. Montgary will cut a station at 350 level before sinking to the final depth of 650 ft. Ore will be stockpiled pending completion of the 1,000- to 1,500-tpd concentrator. A major part of the development drilling has been through ice.

An American firm is negotiating with Montgary for participation in the venture. The firm has already conducted its own drilling program on the property.

New Mexico *(Continued)*

The name of Homestake Sabre Pinon Corp., uranium mine operator in the Ambrosia Lake district, has been changed to Homestake-Sapin. according to Dr. Donald McLaughlin, president of Homestake.

Homestake Mining Co., San Francisco gold mining firm, has a 25% share in profits of the venture and holds operating control.

Sabre Pinon Corp, which owns uranium property in the area, is the other partner.

McLaughlin said shaft sinking is under way on the property. Utah Construction Co. has the contract.

Decision will be made by June 30 on whether to go ahead with the venture and build a 1500-tpd mill.

One of the main questions, according to McLaughlin, is whether the water problems can be solved.

Utah Construction is handling preliminary design for the mill, he said.

NORTH CAROLINA

Bear Creek Mining Co., a subsidiary of the Kennecott Copper Co., has set up offices at Washington, and is seeking mineral rights on 250,000 acres of land in Beaufort County, so that phosphate testing for mining operation can be launched.

It is expected that the mined phosphate will be used either for phosphate for fertilizer or elemental phosphorous for chemical companies, and possibly for both purposes.

Dr. T. E. Gillingham, district engineer for Kennecott, said that there are "many problems connected with the exploration," which will be confined to Beaufort County. "We know the mineral in Beaufort County occurs in low grade concentration," he added, and "to be successful it will require an investment of many millions of dollars."

A bill has been introduced in the North Carolina State Legislature which would require the state's well diggers to supply the State Department of Conservation and Development with samples of well cuttings.

UTAH

V. D. Perry, vice president and chief geologist for Anaconda Co., announced his firm is continuing explorations on copper mineralization in the Bingham district of Utah but that it is "too early to announce any results."

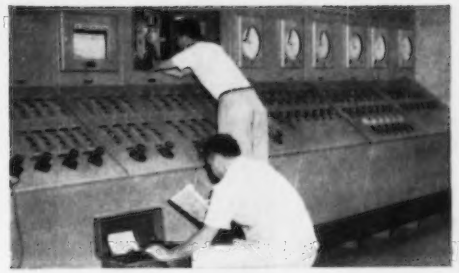
The properties are adjacent to those of the Utah Copper Div., of Kennecott.

Mr. Perry, who said Anaconda was launched on a long-range search for copper, lead and zinc in western hemisphere, including domestic U. S., was placing substantial emphasis on the developments at Park City, Utah, district by United Park City Mines Co. The firm has substantial interests in UPC.

Bear Creek Mining Co., wholly-owned domestic exploration subsidiary of Kennecott Copper Corp., plans additional shafts in probe of its 10,000-acre prospect in Utah's Tintic-Eureka district.

Annual stockholders report of Chief

MARION POWER SHOVEL COMPANY—MARION, OHIO, U. S. A.



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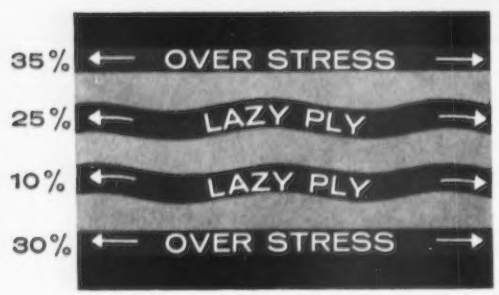

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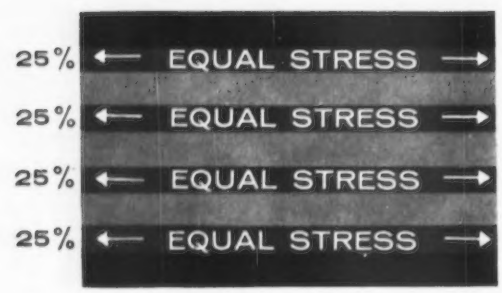

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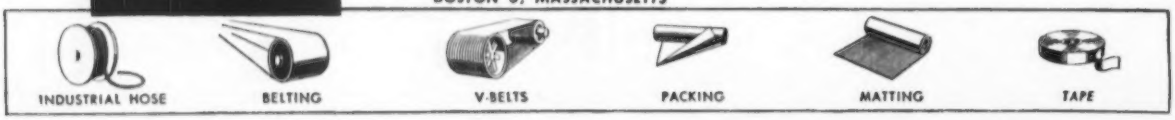

Pheasant hunting in Tacoma, Washington, where many champion field dogs are raised.

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Utah *(Continued)*

Consolidated Mining Co., a partner in the venture on land contribution basis with the Tintic group of companies (Tintic Standard et al), notes:

"Other areas in the 10,000-acre leased area will be ultimately developed by shaft sinking and drifting."

This is first public notice of such intentions.

Cecil Fitch Jr., Eureka, president of the Chief, reported that the present 1,050-ft exploration shaft being sunk on the leased ground for Bear Creek by Centennial Development Co., is below 300 ft. Completion is scheduled in next six months.

Ore-buying station and crushing plant at site of new Texas-Zinc Minerals mill under construction near Mexican Hat were opened early in March.

Station is buying ore from Monument Valley and Ol Jato areas to the south. It will be taking ore from the White Canyon and Red Canyon districts this spring when new road from those areas to Mexican Hat is completed.

Lee Hays of Grand Junction, Colo., general manager for Texas-Zinc, said company hopes to have mill on stream by October.

New supplies of sulphuric acid looms in the Salt Lake Valley on basis of research by Kennecott Copper Corp.

The firm's Western Research Center at Salt Lake City announced construction of a pilot plant which will test flotation of pyritic materials from tailings at its huge Arthur and Magna concentrators serving the big Bingham mine of the Utah Copper Division of KCC.

Pyrites so removed then would be treated for the SO_2 and Fe content, which would be transformed by carbonization to sponge iron.

This sponge iron would replace "detinned" tin cans used in KCC's leach precipitation plant serving the waters which are run over waste rock from the big pit. (KCC recovers many millions of pounds of otherwise-lost copper in this fashion each year.)

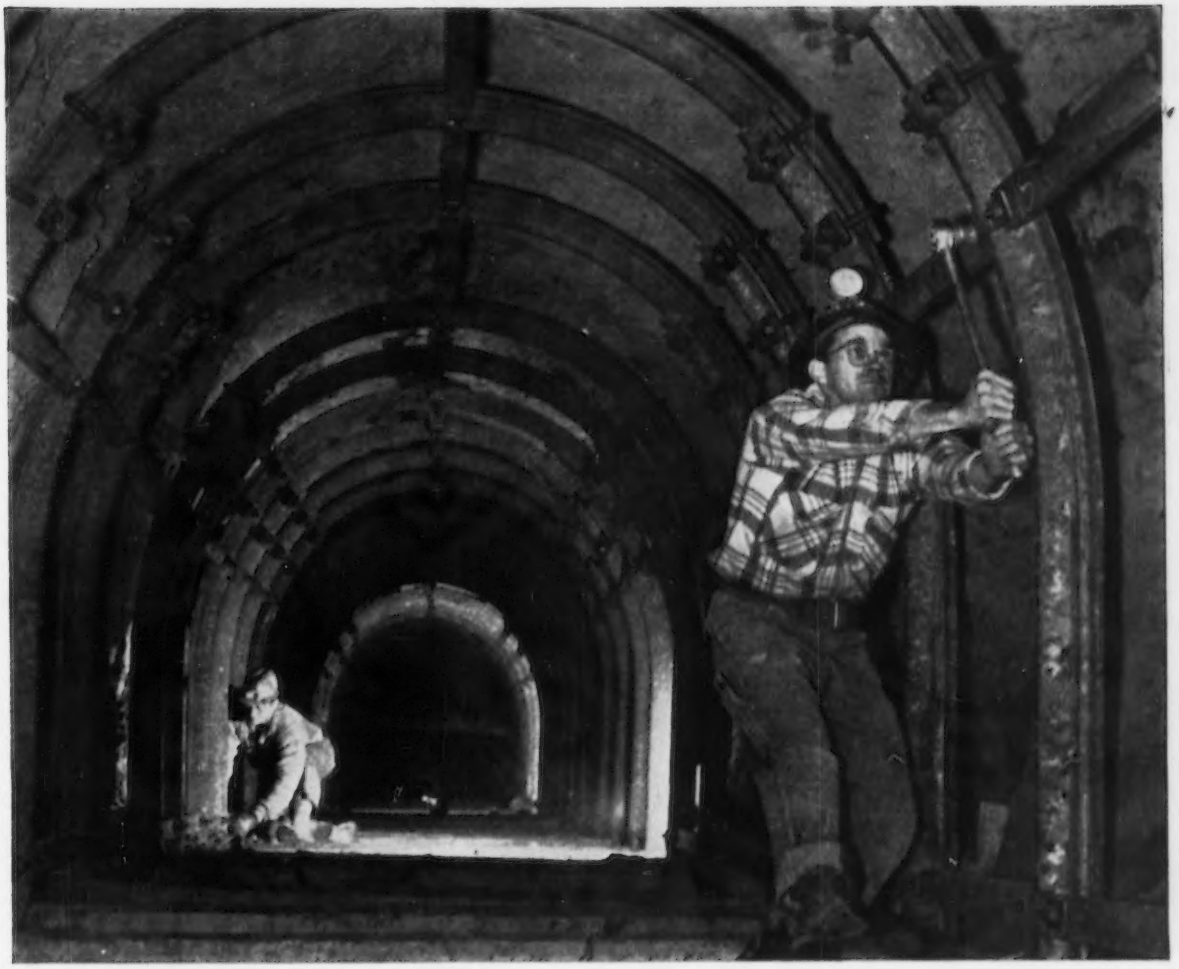
Chemists at the research center estimate that "several hundreds" of tons of sulphuric acid could be produced from the SO_2 resulting from burning the pyrites.

Charles R. Cox, KCC president, New York City, recently announced that the profitable use of the pyrite-tailings recovering system already had been demonstrated on a laboratory basis. That's the reason for going ahead with the pilot plant.

The tailings recovery would not affect recapture of S_2 from converter gases to smelting process. The KCC-AS&R-controlled Garfield Chemical & Manufacturing Co., now produces 1,000 tpd of sulphuric by such recoveries.

WASHINGTON

Dawn Mining Co., has announced the award of an ore hauling contract to Beardmore Transfer Line, Spokane. W. A. Vorda, president of Beardmore, said his firm will haul about 160,000 tons



How quickly do Yieldable Arches pay for themselves?

That's the big question, and a natural one to ask before investing in a high-quality roof support like the Bethlehem Yieldable Arch.

The experience of one iron ore mine, extreme perhaps, may be an indication. The conditions were difficult, and the mine had been using timbers 14 in. and more in diameter, practically touching one another. One by one, these timbers failed in from 4 to 6 weeks.

So they installed Bethlehem Yieldable Arch sets in the caving area. Since installation, sets have yielded sufficiently to bring the roof under control, and mining operations have continued steadily. The operators have conservatively estimated that this installation paid for itself within six months!

While this case is hardly a typical one, this much is sure: in mines having heavy roof conditions the Yieldable Arch will give improved roof support, and will pay for itself gratifyingly soon. That's because no rigid support can indefinitely withstand the dynamic pressures caused by the weight and subsidence of the overburden. Periodic replacement of rigid supports is necessary. The Yieldable Arch, on the other hand, is designed to "give," thus allowing the ground to relax slowly and form its own pressure arch.

Yieldable Arch sets are recoverable, too, for use elsewhere in the mine. They are easy to install without special equipment or costly supervision. One of our engineers will be glad to talk with you about the Yieldable Arch; you can reach him through the nearest Bethlehem office.

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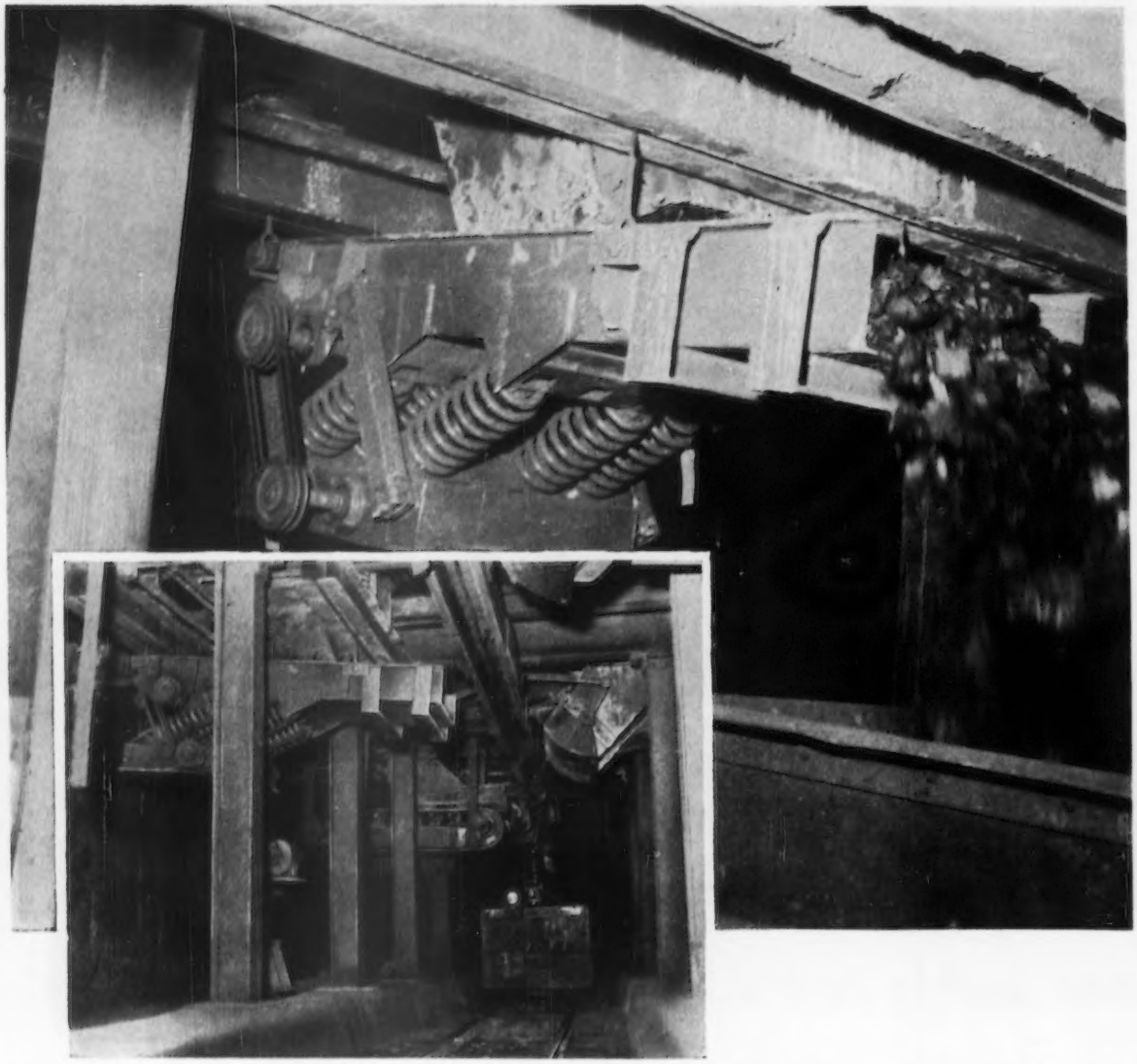

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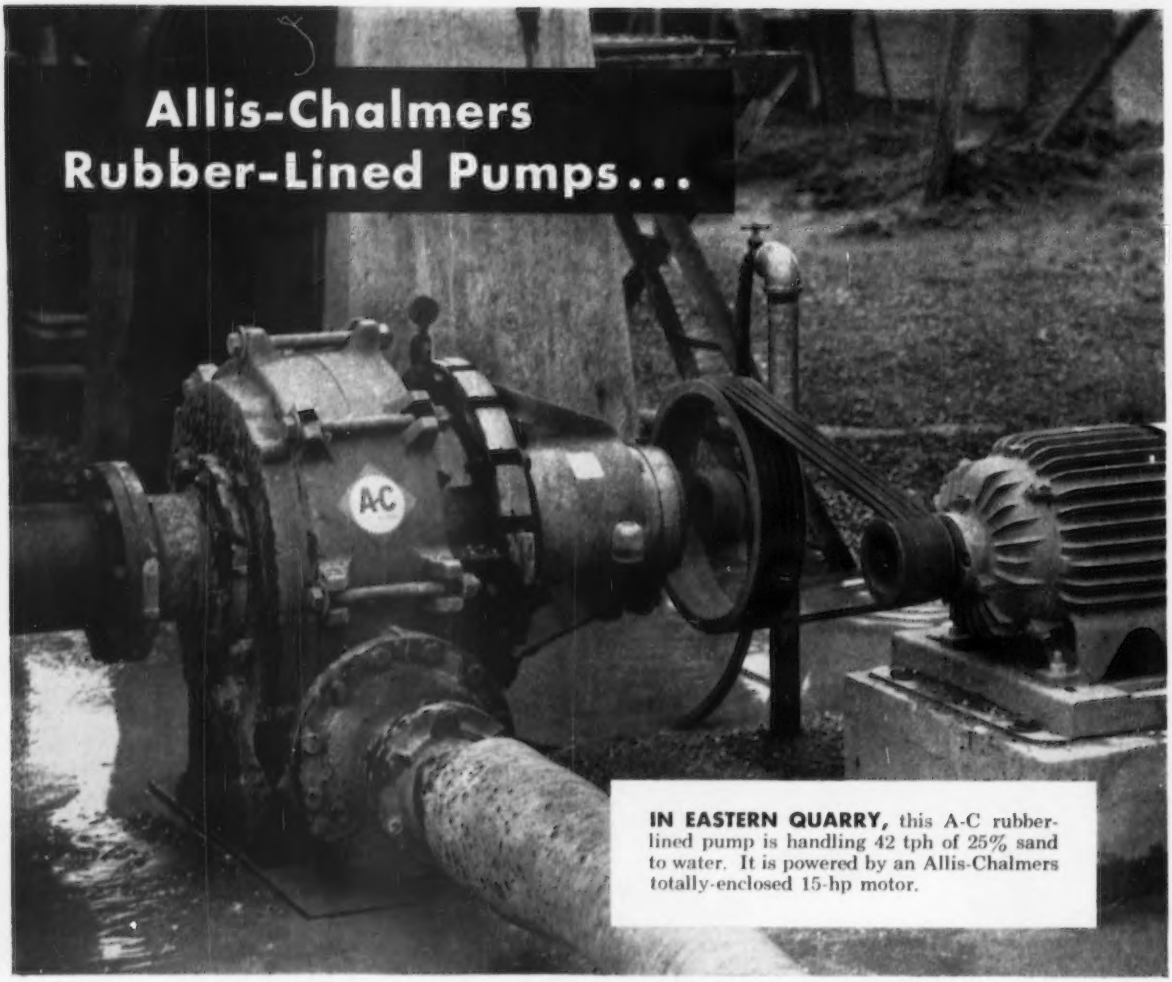

IN EASTERN QUARRY, this A-C rubber-lined pump is handling 42 tph of 25% sand to water. It is powered by an Allis-Chalmers totally-enclosed 15-hp motor.

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Slimes and Slurries

If your pumping application requires handling of slimes, slurries, and other fine mesh abrasives, there's an Allis-Chalmers rubber-lined pump that's built for the job.

Here's a really tough pump designed to keep your pumping costs down, almost eliminate shut-down losses and even do away with standbys in many applications.

Rubber Lining of this A-C pump is bonded to a rugged steel skeleton which is simply fitted to the casing. When lining must be renewed, cartridge-type removal is easy — replacement takes minutes. The pump itself need not be moved.

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ALLIS-CHALMERS

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A-5331

Washington *(Continued)*

of uranium ore from the Midnite mine on the Spokane Indian reservation to Dawn's processing plant now under construction at Ford.

Hauling will be done on a three-shift basis, operating 24 hr a day. Special side-dump trailers with hydraulic gates are being manufactured for the job by Critzer Equipment Co., Spokane.

Grandview Mines plans a limited DMEA drilling program at properties in northern Stevens County. Karl W. Jasper, president, said the work would include about 2300 ft of drilling.

Favorable results from geochemical prospecting on Grandview Mines leases in Stevens County north of the Midnite mine also were reported. Jasper said Mine Consultants, Inc., Spokane, will spend about $87,000 in drilling the ground to prove results of soil sampling.

The report said exploration to date has shown promise of good lead-zinc orebodies in the Anderson open pit mine and Scandia prospect areas.

WYOMING

Atomic Energy Commission in Grand Junction, Colo., will test uranium ores of Globe Mining Co., from the Gas Hills in an alkaline leach pilot plant.

If Gas Hills ores are amenable to the alkaline each process, the first step would be completed toward development of an alkaline circuit that would handle both the low lime Gas Hills ores and high lime ores found elsewhere in Wyoming, particularly in the Little Mountain area near Lovell.

Present mills under construction in the Gas Hills area will employ acid circuits which make milling of high-lime ores economically impossible.

Western Nuclear Corp. (formerly Lost Creek Oil & Uranium Corp.) may ask the AEC for authority to triple the size of its uranium mill now being built at Split Rock.

Robert W. Adams, president, said definite plans for the expansion have not been completed, but said he hoped to ask the AEC to permit enlargement of the mill from 400 to 1200 tpd.

Adams said the uranium potential in the Gas Hills area of Fremont County is so great that two mills now under construction in the area will be inadequate to meet the processing needs.

Five new members were named to the board of directors giving control of the board to Lucky Mc's principal stockholder, Utah Construction Co.

Allen D. Christensen replaces W. H. H. Cranmer as president. Cranmer was retained on the board of directors and was named vice president.

Ground was broken recently on Lucky Mc's $10-million uranium mill in the Gas Hills area.

New directors in addition to Christensen and Cranmer are Marriner F. Eccles, Salt Lake City; E. W. Little-

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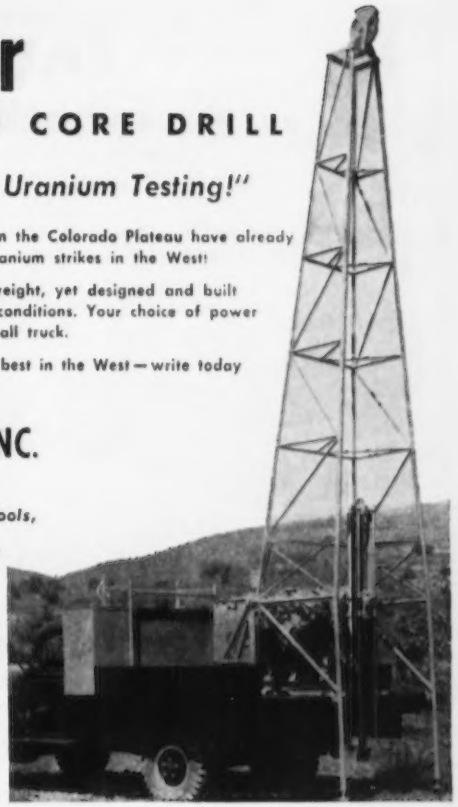

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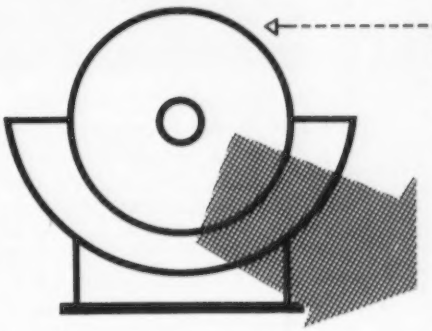

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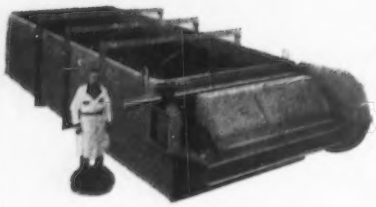

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Wyoming *(Continued)*

field, San Francisco; J. A. Mecia, San Francisco; Weston Bourret, San Francisco; Neil E. McNeice, Riverton; Lowell Morfeld, Riverton; and Robert H. Cranmer, Salt Lake City.

Officers are Littlefield, executive vice president; Mecia, vice president in charge of operations; McNeice, vice president; Robert Cranmer, secretary; J. M. Horrigan, treasurer; and W. D. Leonard, assistant secretary and treasurer.

An exploratory drift into the side of the main hill at Columbia Geneva division of U. S. Steel's iron ore deposits near South Pass City, Wyo., is past the 600-ft mark. It was expected to be completed some time in April.

The drift is part of testing work being done to evaluate the large deposit of low grade iron ore.

The test drift is expected to be completed at a length of about 700 ft, depending upon the material encountered.

Columbia-Geneva is contemplating a $16-million magnetic process mill at South Pass City and a $25-million overall development if the deposits are proven feasible. Columbia-Geneva is seeking an additional iron ore deposit to supplement the supplies available for its Provo, Utah, blast furnace.

Sam Day, Fort Collins, Colo., oil and uranium promoter, has sold a 7½% interest in four uranium claims in the Gas Hills area of Fremont County, to Utah Construction Co.

Internal Revenue Bureau tax stamps affixed to the agreement filed in Fremont County clerk's office indicated the claims were sold for about $70,000.

The claims are the Broadway 1, 2, 4 and 5 claims, located less than two miles south of the Lucky Mc orebody.

Utah Construction Co., is associated with Lucky Mc in developing its properties and construction of a $10-million uranium mill in the Gas Hills area.

Two new uranium companies have made their initial shipments of ore to the AEC buying station at Riverton.

Continental Uranium Co., has entered production in the Crooks Gap area of Fremont County. Big Hill Mining Co., of Shell, delivered a 10-ton trial shipment from its claims near Greybull.

IN CANADA

ONTARIO

Faraday Uranium Mines started milling early in April at an initial rate of 400 tpd at its uranium property in the Bancroft area. The company is the second producer for the area. The mill has a rated capacity of 750 tpd but is capable of handling 1,000 tons. Company holds a contract with Eldorado Mining & Refining for $29,784,800 worth of uranium precipitates. It is understood that this figure may be increased under the terms of an agreement whereby Faraday will

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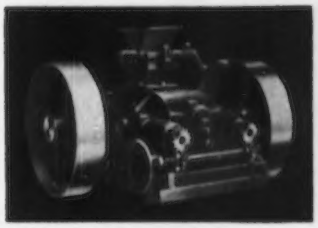
Send for Bulletin 067, which gives full description of all Sturtevant laboratory machines. (Bulletins are also available on Production Crushers, Grinders, Blenders, Air Separators, Micronizers and Automatic Coal Sampler.) Write Sturtevant Mill Company, 101 Clayton St., Boston 22, Mass.

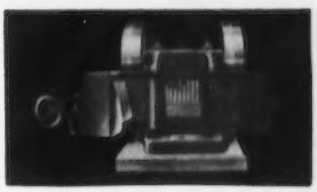
SWING-SLEDGE MILL RETIRES AFTER 25 YEARS...

Ruggedness of Sturtevant machinery is well-known in industry, where even laboratory-size Sturtevant units are sometimes used for round-the-clock production.

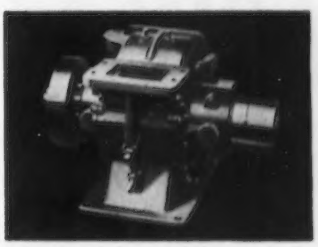
Jas. F. Morse Co., Boston, recently replaced their small-size Swing-Sledge Mill, which had been doing production grinding for 25 years. It was used to grind ⅝ in. tankage into bone meal. Repairs in 25 years? "Just grates and hammers," reports Plant Manager W. Carleton Merrill.



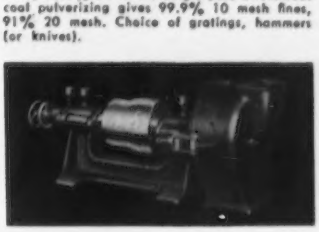
Lab Crushing Rolls: Specially designed for laboratory sampling, Crushing Rolls come in two sizes: 8 x 5 in. and 12 x 12 in. Capacities run as high as 10 tons per hour. Automatic adjustments: 8 x 5 in. model adjusts from ½ in. to 20 mesh; 12 x 12 in. model from ¾ in. to 20 mesh. Tires are high carbon forgings and extra tough. Feeder is automatic, adjustable.



Lab Jaw Crusher: Full or part-time duty for crushing hardest rocks: 2 x 6 in. opening Jaw Crushers have roll jaw action — no clogging. Hard rock capacities: ½ in. setting — 1900 pounds per hour; ¼ in. setting — 1200 pounds per hour; ⅛ in. setting — 800 pounds per hour. Instant in-operation adjustment. Jaw Crushers have manganese steel jaw plates, reversible shields, steel pitman, anti-friction bearings.



Lab Swing-Sledge Mill: 5 x 6 in. feed opening takes soft, medium, tough or fibrous material. Capacity to 1 ton per hour, fines regulated from 1 in. to 20 mesh. Single-pass limestone grinding produces 99.8% 10 mesh fines, 95.8% 20 mesh. Single-pass bituminous coal pulverizing gives 99.9% 10 mesh fines, 91% 20 mesh. Choice of gratings, hammers (or knives).



Sample Grinder: Disc type grinders for dry, friable, soft or medium materials. Three sizes — 6 in., 10 in. and 14 in. take feed as coarse as ¼ in. 100 mesh fines at rates to 200 pounds per hour on largest model. Product regulates from 10 to 100 mesh. In-operation adjustment.

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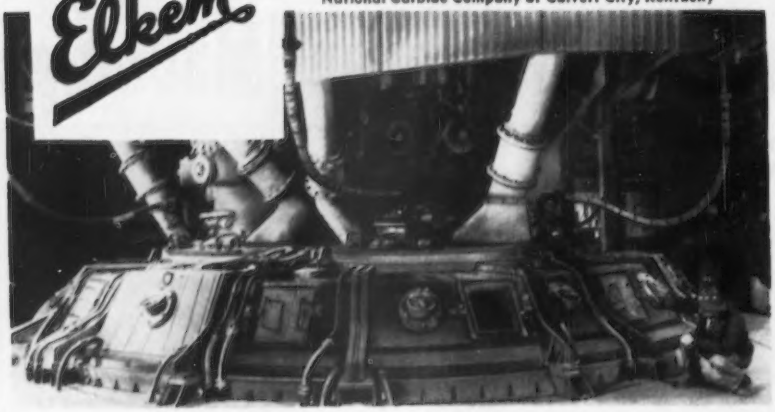

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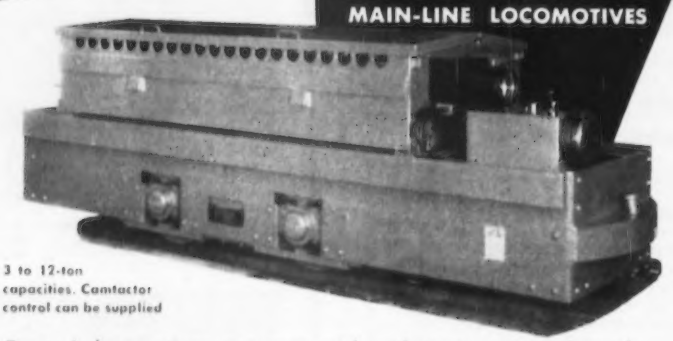

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Ontario *(Continued)*

treat ore from the neighboring Greyhawk Uranium Mines' property on a custom basis. Greyhawk holds a letter of intent from Eldorado for a $20,350,050 contract.

El Sol Gold Mines is adding substantially to indicated tonnage on its iron prospect at Papaonga Lake, 65 miles north of Sioux Lookout. It is estimated that work to the end of March had indicated at least 300-million tons of magnetic averaging about 32% iron. Drilling on both the "A" and "B" zones is continuing.

Nickel Rim Mines is making preparations for the construction of a smelter at its nickel producing property in the Sudbury area. Hopes are that the smelter will be in operation by the end of 1958. During the past year at the company's property, the No. 2 shaft was deepened to 1415 ft to open four new levels, bringing the total to seven. Mill extension was also completed and the mill now has a minimum capacity of 1500 tpd.

Coldstream Copper Mines expects to start milling operations by the end of May or early June at its copper property in the Shebandowan area. Construction on the 1,000-ton mill has made good progress. In the meantime, underground development is continuing with present work being concentrated on the 3, 4 and 5 levels. Initial mill feed will be drawn from the lower levels where grade is well above mine average.

Falconbridge Nickel Mines added some 5.4-million tons to its ore reserves in 1956. Reserves at the end of 1956 stood at 45,259,450 tons averaging 1.43% nickel and 0.75% copper. This was an all-time high. The company now has six producing mines in the Sudbury area with three more under development. Production, now running around 45-million lb of nickel yearly, is expected to reach an ultimate objective of 55-million lb per year during 1958.

Northern Canada Mines is planning exploration of its promising iron property at Savant Lake. A magnetometer survey is to be carried out initially. The company holds some 232 claims covering strike length of an iron formation for over 15 miles. A preliminary magnetometer survey at the south end of the main block of claims showed two iron bands some 250 ft wide lying 300 to 500 ft apart. Sampling returned assays ranging from 28.4 to 44.2% iron with low titanium, phosphorus and sulphur.

QUEBEC

Merrill Island Mining Corp. has started preparations for construction of a 750-ton capacity mill at its copper property in the Chibougamau area. Test work has indicated that copper recovery will be around 95% with recovery of about 70% of the gold and silver. Ore reserves to

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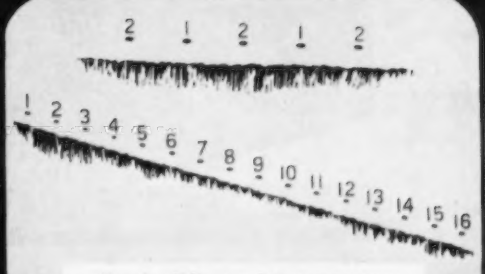

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Quebec *(Continued)*

the 300-ft level were estimated previously at 1,022,000 tons averaging 2.05% copper. It is expected that this tonnage will be increased considerably in development work now in progress on new levels below 300 ft.

Development work is being continued on the three lower levels at the copper property of Duvan Copper Co. in Desmeloizes Twp. Drifting and raising on the upper four levels outlined a total of 103,000 tons grading 2.93% copper. On completion of the current program, decision will be made on mill or treatment plans.

Normetal Mining Corp. increased ore reserves in 1956 at its copper-zinc producing property in Desmeloizes Twp. from 2,675,100 to 3,731,900 tons. Grade averages 2.47% copper and 8.24% zinc, up from 2.41% cooper and 7.71% zinc for the previous estimate. Preparations are now being made to deepen the No. 4 shaft from 5,400 to 6,765 ft.

Portage Island (Chibougamau) Mines is continuing exploration on its 2,400-acre copper prospect in the Chibougamau area. Work to date has indicated 450,000 tons averaging 2.25% copper in one section of the property and 190,000 tons averaging 1.9% in another sector. It is anticipated that at least a full year of drilling and exploration would be required before production could be considered. Of added interest is an estimated 100-million tons of low grade iron, which it is understood could be easily concentrated.

Diamond drilling by Atlin-Ruffner Mines on its optioned copper property in Montgolfier Twp. is adding to tonnage potential. Four drills are currently in operation testing the "D" anomaly. On the basis of four holes, it is estimated there is a possible 200-million tons to depth of 500 ft over a drilled length of 3,600 ft. More than a mile of the anomaly has yet to be tested and only preliminary exploration has been done on other anomalies outlined.

Asbestos Corp. Ltd. plans to close down two of its mines at Thetford Mines, for one year while a modernization program is being carried out, a Canadian press report said.

The King and Beaver mines, situated near Thetford Mines—80 miles south of Quebec City—will be closed in June and reopened in July 1958. Approximately 310 men now are employed in the two mines, and 210 of them will be retained to help with the renovation.

MANITOBA

Rio Canadian Explorations has optioned a group of 110 claims on Wintering Lake, 30 miles south of Inco's Moak Lake development. An active program of exploration will get underway this spring.

Durham Explorations will investigate a nickel showing on its property in con-

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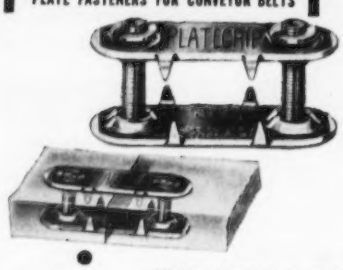

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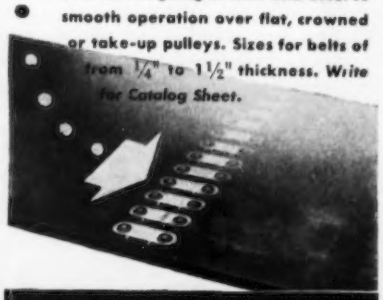

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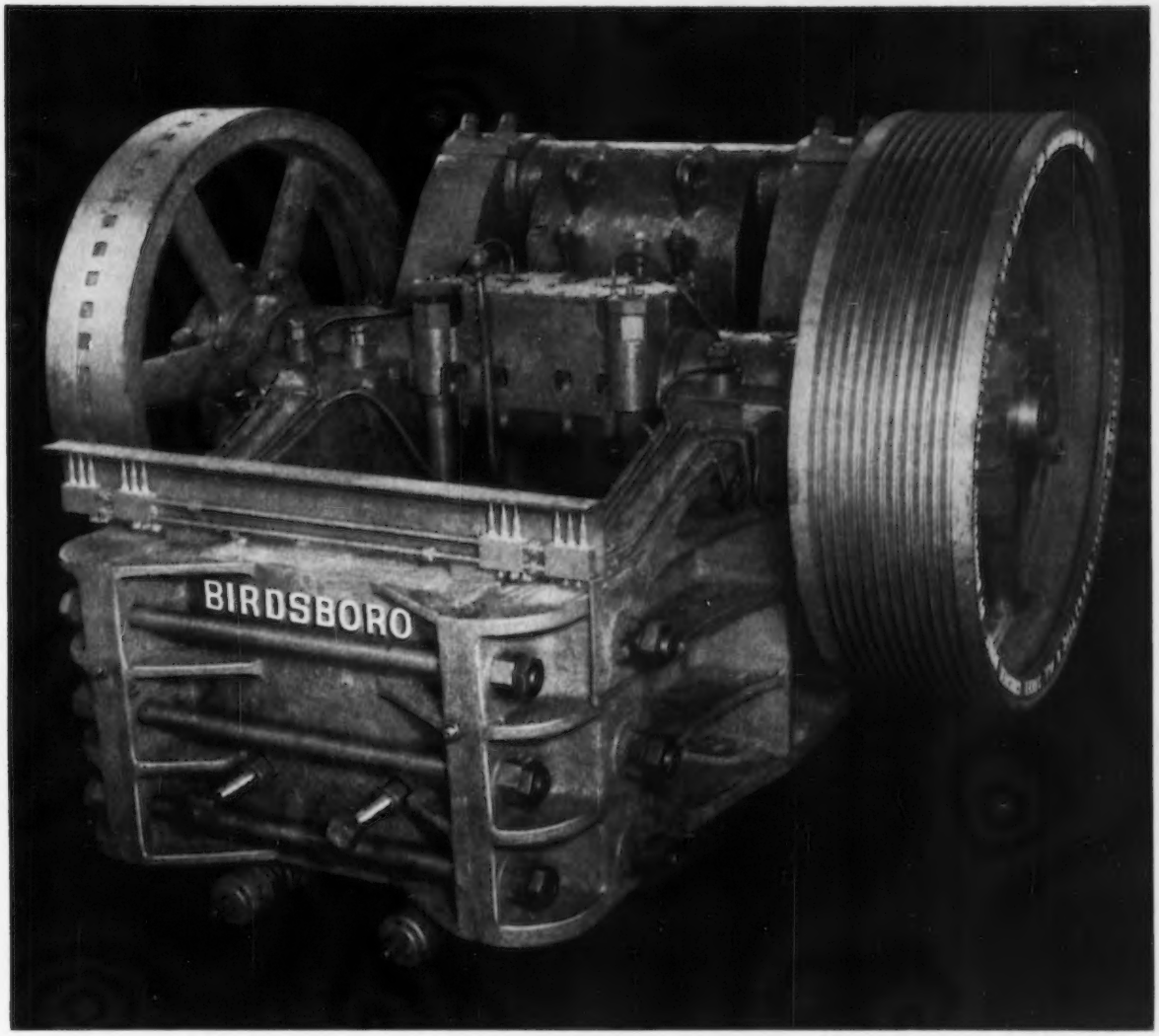

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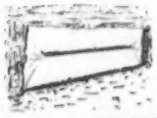

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Manitoba *(Continued)*

junction with Chipman Lake Mines. The favorable zone straddles both properties and cost of drilling will be shared by the two companies. The area under investigation lies east of the Thompson-Moak Lake belt.

Hudson Bay Mining & Smelting Co. reports a net income of $21,007,852 equivalent to $7.62 per share for 1956; an all time record. Over-all ore reserves are given as 20,541,000 tons averaging 0.063 oz gold, 1.09 oz silver, 2.72% copper and 4.8% zinc. The drilling of three new base metal orebodies in the Snow Lake area indicated 5,314,000 tons at the year's end.

Nicoba Mines reports several anomalies have been indicated by recent geophysical work on its claims in the Tramping Lake area. The property is located about 15 miles south of the Hudson Bay Mining & Smelting Chisel Lake development. A program of diamond drilling has been outlined. Midrim Mining and Taranco Holdings also have an interest in the 400-claim property.

ALBERTA

First units of Lorado Uranium Mines' custom milling plant in the Uranium City Beaverlodge area was expected to go into operation in April.

Initially, the new mill will handle 500 tpd ore and work up gradually to 750-ton capacity. Construction was started last June.

Announcement was made by the Alberta and Northwest Chamber of Mines and Resources, Edmonton.

The chamber stated that "a considerable saving in milling costs will result from the manufacture of sulphuric acid, used in the leaching process, from pyrite deposits located on the Lorado property."

Lorado, which has a contract to supply Eldorado Mining & Refining Ltd., with $64.48-million worth of uranium, also has contracted to mill ore from five other uranium producers in the area. These are Black Bay Uranium, Cayzor Athabasca, Lake Cinch, National Exploration and St. Michaels.

The Chamber said that these producers have been stockpiling ore for months in preparation for the advent of Lorado's milling facilities.

BRITISH COLUMBIA

British Columbia's mining industry last month lost a strenuous battle to block passage of mining legislation which it claims will force closure of iron mining operations, drive development capital away from the province and leave the industry at the mercy of government officials.

The new legislation eliminates the old system of giving prospectors Crown grants in perpetuity on land which they have staked and prospected for five years, and substitutes instead a system of Crown leases (as is already done in the case of oil, gas and placer mining and coal lands) which can be renewed every 21 years if companies can show "adequate" production record during that period; and it prevents export of ore from new claims until the government has established that British Columbia's own needs have first been met.

It means that additional iron ore cannot be shipped to Japan from B.C.

IN LATIN AMERICA

CHILE

Government has authorized Marvis and Co. of Panamá, controlled by Mauricio Hochschild & Co., to invest $4.5-million more in their copper deposit of Mantos Blancos, 30 miles east from the port of Antofagasta. The Hochschild interests bought this property from IFMIA (Instituto de Fomento Minero e Industria al de Antofagasta), a defunct fiscal agency and the de la Fuente family which had owned this property for many years. Señor Mauricio Hochschild has not yet acquired the claims belonging to Señor Juan Rochefort, a well-known mining engineer and operator of copper mines in central Chile. Ore found in the Mantos Blancos deposit is all oxidized and most of the copper is found as atacamite.

Some 20-million tons of ore have been proved by churn and diamond drills, but the total tonnage of ore is probably much larger. This ore is difficult to treat because some 80% of the copper is found as atacamite and another 12% as chrysocolla. At the pilot plant built at the port of Antofagasta the ore is dissolved in weak sulphuric acid and then the solution is worked up to about 45 grams per liter of copper and strengthened in chlorine by means of sodium chloride for conversion of all the copper into cuprous chloride. The copper is then precipated by means of SO_2, the white, crystalline salt being separated from the barren solution by centrifugation.

The copper salt is then mixed with coke and hydrated lime and treated in a pug mill so as to ball up the mixture. The balls together with lime are fed together to a short furnace similar to a kiln and heated above melting point. The chlorine combines with the lime to form calcium chloride which comes out of the furnace as a slag; the copper assaying 99.9% fine which, by poling, can be brought up to fire-refined copper.

GUATEMALA

A joint venture of San Luis Mining Co., New Park Mining Co. and a group of wealthy Bostonians seeks production

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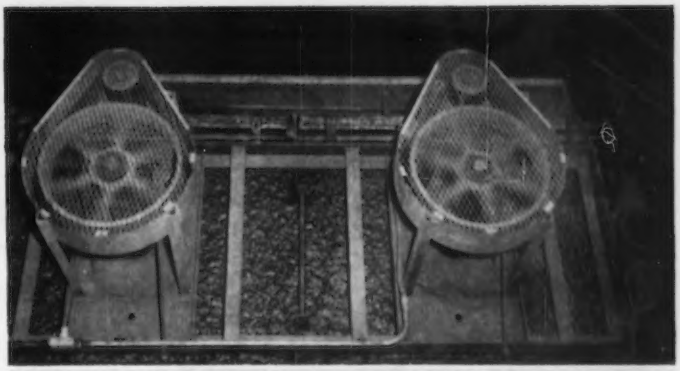
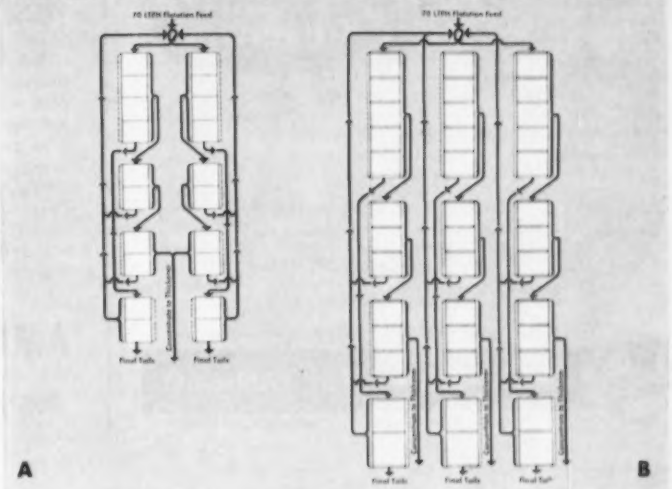


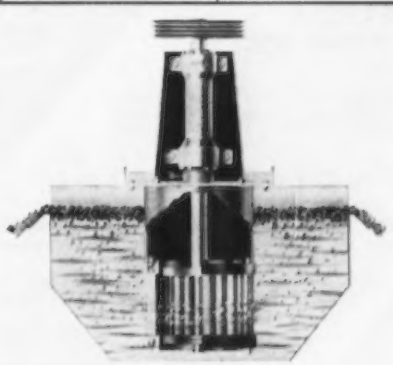
here's the proof: In an efficient new iron flotation concentrator, two parallel flotation circuits are used. Each receives identical feed, and each handles 70 long tons per hour with grade meeting market requirements. Check and compare these facts:



		Wemco Fagergren Units A	Other Flotation Units B
Circuit Characteristics	✓ Number of Cells	20	39
	✓ Gross Cell Volume[1]	1220 cu. ft.	2400 cu. ft.
	✓ Floor space (all cells)	644 sq. ft.	988 sq. ft.
	✓ Launder & Operating aisles (approx.)	167 sq. ft.	261 sq. ft.
	✓ Total Launder Length (approx.)[2]	225 ft.	375 ft.
Typical Metallurgical Results on This Type of Iron	✓ Units of Iron Recovered	1%-2% more	
	✓ Tailings Loss	1%-2% less	
	✓ Reagent Consumption	.2-.3 lbs. less per ton treated	

Notes: 1 – Taggart, Section 12 page 80, shows WEMCO-Fagergren efficiency of cell volume substantially greater than others, in addition to the above noted advantage in space alone.

2 – Shorter launder length in WEMCO circuit allows steeper slope; requires less wash water, causing less dilution of concentrate and minimizing dewatering requirements.



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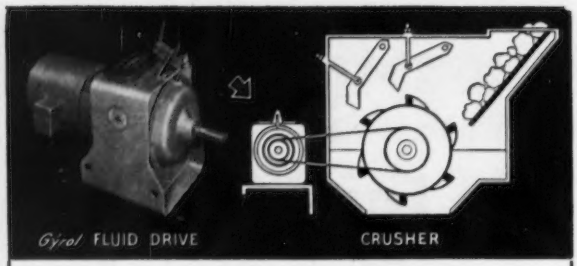

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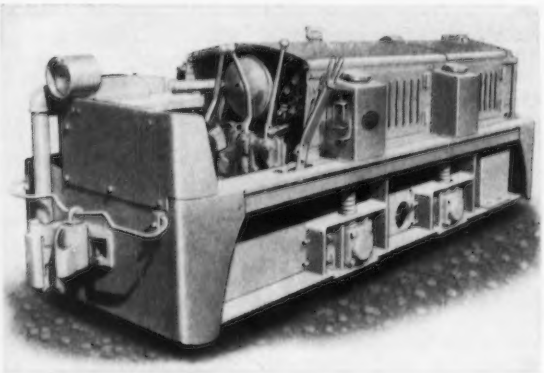

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Guatemala *(Continued)*

of lead-zinc carbonate ores in the Huehuetnango area of northwestern Guatemala.

The groups, each sharing 33½% interest in Compania Minera Maya, S. A., control substantial acreage in three distinct areas of the province just south of the Mexican border.

Work at present is dedicated to drifting and crosscutting the high grade ore reserves found in pipes and "books" of limestone replacement type depositions which outcrop in substantial fashion on the surface.

For New Park, a Park City, Utah, district producer, it is the first venture into the foreign mining field.

Robert L. Cranmer, Salt Lake City, secretary and counsel of New Park, had this comment on the changed position of New Park:

"In view of the trend of the national policy toward domestic mining interests in the U.S. the last seven years, we have no alternative but to seek to protect the company and its shareholders" in seeking foreign production.

Mr. Cranmer identified J. W. Swent, San Francisco, president of San Luis and vice president of Homestake Mining Co. and Robert Strange, Boston, Mass., as serving on Compania Minera's operating committee.

Mr. Strange represents the Boston syndicate.

San Luis, the "mining arm" of the estate of William Randolph Hearst, is a substantial shareholder in Homestake. The latter firm has no interests in the Compania Minera Maya, S. A.

Compania Minera hopes to truck its lead carbonate ore from the three mines to the nearby Pan America highway along which it will be hauled to smelters in Mexico.

IN THE PHILIPPINES

Surigao Consolidated has optioned a promising prospect for copper about 26 km south of the Sipalay mine in Negros. Drilling will start in May. The company has stopped work on its copper property in Zambales although a limited amount of 3% ore was developed, probably enough to support a small mill.

Elsewhere in Zambales better results were reported by Mindanao Mother Lode Mines which milled 7900 tons in February averaging 2.8% copper and produced 815 tons of 25% concentrates. Over-all recovery was nearly 94%.

Gold mining has been resumed by Benguet Exploration Inc., under a management contract with Philex Mining Corp. A mill is being built on the company's Thanksgiving group of claims near Baguio. Production is expected in July. Paul A. Schafer is president.

February saw a sharp stepup in production at the Toledo copper mine in Cebu operated by Atlas Consolidated M.&D. Co. In 26 working days a total of 209,000 tons were milled, an average of 8,041 tpd, with the first 9,000-ton day recorded in the last week. Grade of ore milled registered a gain over January with heads reaching 0.71% copper. Concentrates totalled 6,183 tons of 20.7% grade. According to the company's annual report a net profit of $3,395,000 was realized in 1956 from total sales of over $10-million.

According to reports from Baguio, Batong Buhay, a pre-war gold mine that saw no more than a year of operation before being shut down during the invasion, will be re-opened under new financial arrangements. The property is about 250 km north of Baguio in the remote Kalinga country. It attracted wide attention because of the high grade of its ore and the unusual difficulties encountered in building a mill in so inaccessible a region.

Central Bank of the Philippines has authorized the use of blocked peso deposits of non-residents for direct purchase of gold bullion in the domestic free market up to 25% of the total gold bullion output of local mining companies. This ruling should be of substantial benefit to local gold miners. At present gold bullion is selling on the open market for about P124 per oz. Before the ruling the open market price was about P110 an oz. However the gold producers are not allowed to sell over 25% of their output on the open market. The balance must be sold to

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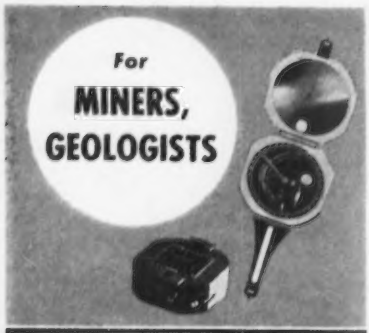

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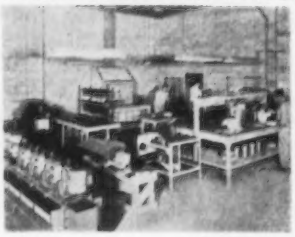

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Philippines *(Continued)*

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IN AUSTRALIA

Montana Silver Lead N.L. has discovered at its Zeehan, Tasmania, property a substantial tonnage of copper-nickel ore with high-grade ore up to and exceeding 8% nickel and milling ore from 0.75% to 3% nickel.

A feature of deposit is the occurrence of dense sulphide nickel-copper ore assaying 8 to 14 % nickel and 4 to 5 % copper which can be mined and shipped overseas without prior treatment. Some of the rich leases are 70 to 100 ft long with widths varying from 1 to 10 ft.

Australian mine production of zinc in 1956 has increased by about 30,000 long tons to 285,000 long tons. Production of refined metal was 104,762 tons of which 35,000 tons were available for export.

Improvement in power availability in Tasmania will mean an increase in the production of refined zinc to 115,000 long tons a year by the end of 1957.

Australian production of tin in 1956 was about 1,900 long tons or some 100 tons lower than in 1955. Production of refined tin for the year was 1,850 long tons. Experts expect an increase in output in 1957 when the Tableland dredge will work a higher grade ground and the Ravenshoe dredge will also come into operation.

Australia is at present producing sufficient metallurgical manganese ore to meet all the domestic requirements. About 1,000 tons per week of 42½% Mn ore is being produced from the Horseshoe group of leases in Western Australia and a low price of only about $22 to $25 per ton is being received at Western Australian ports.

Mining Corp. (Austr.) N.L., which is drilling for an extension of the Mt. Isa orebodies, reports having passed through copper mineralization from 1750 to 1860 ft. Latest intersection is about 1,000 ft west of the mineralization disclosed in Hole No. 1. Assays are not yet available. At Mt. Cobalt, drilling operations have begun on Hole No. 18.

Production of crocidolite asbestos at Wittenoom, Western Australia, is being steadily increased and the 1956 tonnage was close to 7,000 long tons. On the other hand, imports of all types of asbestos have dropped about 32% below 1955 levels. The 1955 imports were well in excess of Australia's requirements and large stocks have been built up.

Japan is to import about 21,000 long tons of zinc concentrates from Australia. Shipments will take place in April-May and the concentrates (avg. content 52%.) will come from the New Broken Hill mine. Daiichi Bussan Kaisha of Japan are the purchasers and this is the first Japanese order for zinc concentrates in Australia.

IN AFRICA

Federation of Rhodesia and Nyasaland had more trade with the United States than with any other non-British country in 1956. The U. S. took 7.3% of Rhodesian exports and supplied 5.9% of Rhodesian imports. There was a big reduction in value of shipments of copper to the U. S. compared with 1955.

Portuguese Minister of Overseas Territories announced that Portugal has entered into an agreement with the Billiton Maatschappij of The Hague, whereby the latter will be entitled to explore and eventually to exploit bauxite reserves in Angola. As a result of the agreement the Billiton Co. will have to establish a Portuguese subsidiary with a capital of at least 5-million escudos, 60% of which will be reverted into Portuguese interests. The concession has been given for 5 years, eventually to be extended to 7 years; the exploiting concession, however, for 70 years, will eventually be extended to 90 years.

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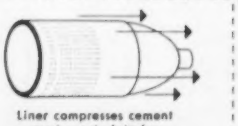
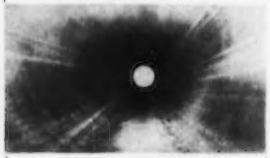


Liner compresses cement mortar onto interior



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LONGER LIFE!

DeZurik Valves have these Exclusive Features

ECCENTRIC ACTION

backs the plug away from the seat —no scraping or binding, no galling or grinding—easy quarter-turn from wide open to dead-shut.

RESILIENT PLUG FACINGS

insure tight shut-off—even with solids in the flow! Sandy slurries *won't* score the plug-face—can't cause leakage and valve failure!

TIGHT SHUT-OFF

is guaranteed. The resilient-faced plug seals *around* solids in the flow, delivering perfect performance every time on any line!

NO LUBRICATION

is required with DeZurik plug Valves. Eccentric action assures easy operation — resilient plug facings deliver tight shut-off—WITHOUT LUBRICATION!

DeZurik Plug Valves are the logical choice for so many mining applications. On hard-to-handle slurries, they shut tight and last longer; on critical services there is no danger of contamination from lubricants; and on any service they operate easily!

These versatile DeZurik Valves have features found on NO OTHER VALVE! Only DeZurik Valves have Eccentric Action, combined with resilient plug facings, guaranteeing easy operation and dead-tight shut-off WITHOUT LUBRICATION.

Before you specify new or replacement valves on that difficult service, get the complete story on DeZurik Valves. Representatives in all principal cities; or write

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NEW, SAFE and AUTOMATIC

Mayo Mine Car Coupler

. . . the coupler with the mating instinct

Mayo's new, cast steel coupler for narrow gauge mine cars couples instantly on tangent or curves. Safe, self-centering link completely eliminates all hazards of hand coupling. Only a little more expensive than link-and-pin, it more than pays for itself by preventing accidents. If you can save one smashed finger, you've got these couplers paid for. Easily installed by bolting to existing cars. Write for Bulletin No. 21.

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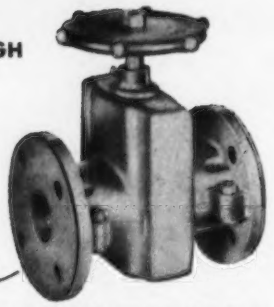

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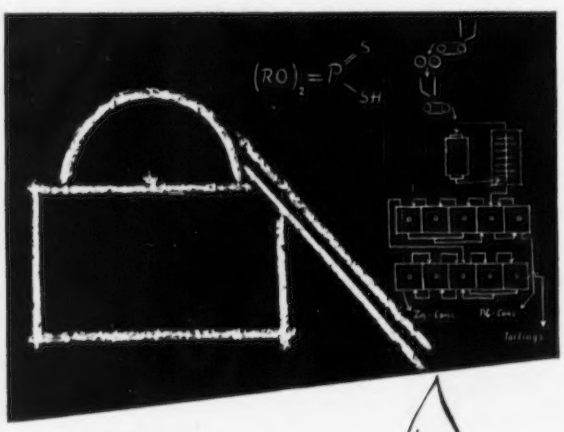

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Reversible tramming motors enable the Tracdril to whip into reverse, go forward and pivot . . . have "dead man controls" for greater safety.

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8 East 44th Street, New York 17, N. Y.

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Excellent opportunities for engineers in mining, milling and engineering in a titanium and iron mine located in northern New York.

ASSISTANT MILL SUPERINTENDENT

Graduate metallurgical or mining engineer with background in ore dressing and some production experience in maintenance and operation of crushing and milling equipment. Salary range $7,000 to $8,500 per year.

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Engineering graduate to assist chief engineer in development of metallurgical, structural and mechanical design. Experience required. Salary range $6,200 to $7,500 per year.

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Graduate engineer to prepare detailed drawings on development of structural and mechanical design. Salary range $5,500 to $6,500 per year.

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Graduate mining engineer to do general surveying and mining engineering in connection with an open pit mine. Salary range $5,000 to $6,000 per year.

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Graduate metallurgist to conduct tests on ore samples and to investigate problems in metallurgical control in a 6,000 ton per day concentrator. Salary range $5,000 to $6,000 per year.

Apply for application form to:

Engineering Dept.

NATIONAL LEAD COMPANY

Tahawus, New York

MINING ENGINEERS, GEOLOGISTS AND METALLURGISTS

interested in making contact with *established Canadian mining companies* with a view to employment are invited to write to

CANADIAN METAL MINING ASSOCIATION
Room 335, 12 Richmond St. East
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The Association will be pleased to furnish information concerning mining companies in Canada to which enquiries about employment opportunities can be directed. Enquiries would be welcomed also from trained and well-qualified mechanics, machinists, electricians and tradesmen.

POSITIONS VACANT

Assistant Superintendent for Laredo Antimony smelter to take charge of process improvement. Should be active and have practical smelting background with blast furnace experience. Salary commensurate with experience. Address Box 559, Laredo, Texas.

Replies (Box No.): Address to office nearest you
c/o This publication Classified Adv. Div.
NEW YORK: P. O. BOX 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 69 Post St. (4)

POSITIONS VACANT

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Metallurgical Engineer Wanted—Metallurgist for operating Uranium Mill in Colorado Plateau. Age 35-45, with experience in extractive and hydrometallurgy. Knowledge of ion-exchange principles desirable, but operating and supervisory experience in grinding, classification, and leaching considered more essential. Liberal housing and employee benefits. Well-established, medium-sized company, offering advancement as operations expand. Salary $8,500-$9,500. P-4800, Engineering and Mining Journal.

Mining Engineer—Graduate with 5 to 10 years varied experience in geology, exploration, operations and construction. Need man who is versatile and adaptable, has knowledge of costs and ability to write reports. Job consists of work on a variety of engineering and research projects. Salary open, location Denver area. Reply with full details to Colorado School of Mines Research Foundation, Inc., Golden, Colorado.

Mining Geologist—Minerals division of large in- dependent oil company seeks geologist with diversified experience in mining geology. Age 25 to 35. Salary open. P-4884, Engineering and Mining Journal.

Electrical-Mechanical Engineer—Large anthra- cite coal mining operation northeastern Pennsylvania, to take responsible charge design, construction and maintenance. Mining experience desirable but not required. Submit qualifications, experience, personal status and salary expected. P-4887, Engineering and Mining Journal.

Coal Mining Engineer with minimum ten years experience in coal mining industry, including exploration and evelopment work, and supervisory work at production and management levels in underground coal mines. Must be familiar with all types of mining methods and equipment. Engineer with experience in thin seam mining preferred. This is consulting staff position; 12 to 15 months foreign service; good living conditions; substantial salary and quarters allowance; wife accompany. Age 40 to 65. Write P-4954, Engineering and Mining Journal.

Mining Engineer—Geologist with minimum ten years work in mining industry including minerals exploration, mining development and improvement and mine operations. This is consulting staff position; 12 to 15 months foreign service; good living conditions; substantial salary and quarters allowance; wife accompany. Age 40 to 65. Write P-4953, Engineering and Mining Journal.

Engineer to handle assignment of extensive pros- pecting and development of diamond placer property in French Equatorial Africa. Speaking knowledge of French desirable. Single status until quarters available. Yearly salary $7500 (U.S.) plus living expense to qualified applicant. Contact Natomas Company direct at Natoma, California.

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Mining Engineer, Thirty years operating, en- gineering and management of highly successful, economic properties. Available part or full time after June. All inquiries confidential. Reply PW-4316, Engineering & Mining Journal.

General Manager, mining salary $24,000. Em- ployed, available thirty days notice. PW-4283, Engineering & Mining Journal.

Mining and Metallurgical Engineer. Mexican, fluent English. Fifteen years dealing with metal mining practice. Experience in installations and maintenance of electrical and mechanical equipment. Mine plant design. Construction and operation of Flotation Mills. Labor handling. Desires management position of small mine in process of development or in operation, preferably South America. PW-4222, Engineering & Mining Journal.

Metallurgical Engineer, 36, family. Registered P.E. 9 years varied experience application sales and service of ore dressing and processing equipment. Seeking responsible connection at supervisory or management level with progressive operating company in minerals or chemical field. Interests lie along the lines of process and equipment development and control, but will consider other propositions. PW-3565, Engineering & Mining Journal.

Mining Engineer seeks position management preferably in Mexico, 51 years, married, excellent health. Broad experience and good record for 25 years exploration, development, operation, mine-mill installation, costs and labor non-ferrous mining. Available June 1st. PW-4902, Engineering and Mining Journal.

Canadian mining engineer, age 26, 5 years ex- perience mill operation and maintenance with major mining company. Interested in employment with consulting or engineering firm, Canada or U.S., but all offers considered. PW-4961, Engineering and Mining Journal.

Geological Engineer, Ph.D. Twenty years ex- perience in Canada and Western United States. Mine examination, evaluation, development, management. Available as consultant, part- or full-time representative for company interested in exploration. PW-4984, Engineering and Mining Journal.

Metallurgical Engineer, age 40, wide background ore dressing research, development ,and operation. Desires similar type of position with progressive company. Full details of experience on request. PW-4986, Engineering and Mining Journal.

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For Sale: Tremendous quantity of talc of finest quality. Also lands containing gold and copper deposits. Address all communications to P.O. Box 22, Seagrove, N. C.

6—Gardner-Denver, model D-99 auto, drifters, used, reconditioned, $250 each. AL 5-9368, Rm. 300, Travel Center Bldg., Denver 2, Colorado.

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15,000 TON/DAY—JUNEAU, ALASKA

EXCELLENT HARBOR FACILITIES FOR EXPORT

800 HP Nordberg Double Drum Hoist

Compressors:
1—2300 CFM Type PRE-2 Ingersoll-Rand 500 HP Synchronous mtr. & Electric controls.
1—1500 CFM Worthington Size 23 & 14 x 16, 300 HP Synchronous mtr, Excellent.

Hoists:
1—50 HP Ottumwa, 1 drum
1—100 HP Coeur d'Alene, 1 drum w/motor and controls.
1—150 HP Wellman-Seaver-Morgan, 2-drum mine shaft hoist, 8400# at 500 FPM, herringbone gears, post brakes, excellent unit.
1—300 HP Wellman-Seaver-Morgan, 1-drum 16,-500# at 825 FPM, herringbone gears, dynamic braking.
1—800 HP Nordberg Double Drum 43,700 lbs. pull at 100 FPM, can be converted to 1600 HP, Sectional construction, pass thru 7'x6'10", powered by 800 HP 600 VDC motor. Excellent. Write for specs.

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140—10 ton Capacity rotary dump 30" ga.
28—4½ ton cap. Granby type, 30" ga.
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42 tons—50# rail
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80 tons—72# rail

Locomotives:
3—18 ton Baldwin Westinghouse trolley 30" gauge.

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1—S211 Sullivan, air.
1—HDAE Sullivan, air
1—HDA-15 Sullivan, air, 15 HP.
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1—HNNIJ Ingersoll-Rand, Air.
3—E-112 Sullivan, Air.

Blowers:
1—SP-175 Coppus Vano.

Drills:
1—Mitchell Diamond Drill, air motor, underground Type, for Ex Rod.

Motors, Spare
1—225 HP West. 435 RPM, 2200 V.
1—150 HP G.E. 720 RPM, 2200 V.
1—150 HP West. 428 RPM, 2200 V.
2—150 HP West. 435 RPM, 2200 V.
1—350 HP West, 360 RPM, 2200 V.
2—100 HP G.E. 450 RPM, 2200 V.
Lots of new motors and gearmotors, too numerous to mention.
Lots of switches, switchgear.

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4,000' 500 MCM 3-cond. 3000V lead armor, galvanized spiral wire, wrapped.
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Transformers:
3—667 KVA, G.E. 22000 to 2300/4000 V
1—300 KVA, West. 2300 to 440 V.
1—100 KVA, West. 2400 to 240/120 V.

Mine Telephones:
8—Western Electric, brand new.

Magnetic Head Pulley:
1—26" x 24" Dia. Magnetic Head Pulley

Shop Equipment
1—48" New Haven Planing Machine, 6' table
1—20" CF Eberhardts shaper
1—4" Cap. Acme Bolt Threader
1—12" Swing x 6' LeBlondes Lathe
1—16" Swing x 5' Lodge & Shipley, Quick change lathe.
1—48" swing x 25' Prentiss Lathe
1—24" swing x 16 Lodge & Shipley, quick change
1—48" swing x 25' Prentis Lathe
1—24" swing x 16' Lodge & Shipley, quick change lathe
1—14" Armstrong Power Hack Saw
1—2" Acme Pipe & Bolt threader
1—6' Set Plate rolls w/7½ HP Mtr.
1—Ryerson Boiler Plate Punch, hv. duty
1—2" Saunders & Son Threader
1—17" Racine Power Hack Saw
1—24" swing x 10' Lathe, quick change
1—24" swing x 8' South Bend, quick change
1—18" swing x 6' American Quick Change
1—American Radial drill, 3' arm, multi-speed
1—12" Column Manning Maxwell & Moore radial drill press, 5' arm
1—60" Swing x 22' bed, Niles, quick change, late model

Flotation Machines:
2—6 cell Denver #18 Flotation
1—6-cell Denver #30, 15 HP Mtr. dual drives
3—5-cell 66" x 66" Fagregren

Pumps, Sand
2—1" Wilfley, Iron
2—2" Wilfley, Iron
1—3" Wilfley, Iron
16—4" Wilfley, overhead motor mounts
7—8" Wilfley with 75 HP Mtrs.
2—2" Denver Vertical Sand Pumps

Assay & Lab Equipment
1—2000gm. Lab Float Cell
2—DFC Muffle Furnaces
3—Braun UA Pulverizer
1—6" x 10" Crushing Rolls
1—Braun Chipmunk Crusher, New
1—Tyler Rotap Machine

Screens
8—4'x5' Tyler Hummer, w/vibrating heads
7—3'x6' Tyler Niagara
4—4'x8' Tyler Niagara
3—2'x4½' Tyler Niagara

Crushers
3—9-K Allis-Chalmers gyratory, no motor
2—6-K Allis-Chalmers gyratory
3—36" x 48" Buchanan Jaw Crushers w/150 HP Motors
2—60"x24" Traylor Rolls, each complete with drive motors

Mills
12—8 x 6 Marcy Type Ball Mills, 225 HP motors
2—8 x 6 Marcy Type Ball Mills, helical gears, wave type liners, 225 HP Syn Motors, Excellent
2—6 x 9 Allis-Chalmers Ball Mills, 150 HP Motors
7—6 x 12 Allis-Chalmers Ball Mills, 150 HP Motors
1—5 x 5 Allis-Chalmers Ball Mill

Dust Collectors
1—8' dia. Cyclone Dust Collector

Magnets
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ALPHABETICAL INDEX TO ADVERTISERS

*** Indicates more product information may be found in company advertising appearing in E&MJ 1956 Mid-June Mining Guidebook and Buying Directory Issue. Check your Guidebook index.**

Acker Drill Co. 207
Adamas Carbide Corp. 30
*Aero Service Corp. 196
*Ainsworth & Sons, Inc., Wm. 220
*Allen-Sherman-Hoff Pump Co. Second Cover
*Allis-Chalmers Manufacturing Co., (Power Equipment Div.) Insert between pp. 18-19
*Allis-Chalmers Manufacturing Co., (Industrial Equipment Div.) 133, 164-165
*Allis-Chalmers Manufacturing Co., (General Products Div.) 38, 206
*Allis-Chalmers (Construction Machinery Div.) 45, 174-175
*American Air Filter Co., Inc. 50A
American Blower Div. of American-Standard 216
*American Brattice Cloth Corp. 214
*American Cyanamid Co. Insert between pp. 50-51
American Manganese Steel Div., American Brake Shoe Co. 52
*American Steel & Wire Div. 54-55, 130-131
Armour & Co. 150-151
Armstrong-Bray & Co. 212
*Athey Products Corp. 141
Atlas Car & Mfg. Co. 210
Atlas Powder Co. 211

*Baker & Adamson General Chemical Div., Allied Chemical & Dye Corp. 194
*Baldwin-Lima-Hamilton Corp., Eddystone Div. 176
Bemis Bro. Bag Co. 202
Bethlehem Steel Co. 18A, 203
Birdsboro Steel Foundry & Machine Co. 213
*Bixby-Zimmer Engineering Co. 212
Booth Co. 220
Boston Woven Hose & Rubber Co. 200
*Brunner & Lay, Inc. 178
Bucyrus-Erie Co. 142, 177
*Buell Engineering Co. 144
Bunker Hill Co. 224

*Carpco Manufacturing, Inc. 117
Carrier Conveyor Corp. 204
Case Co., J. I. 111
Caterpillar Tractor Co. 42, 127, 234
Chicago Pneumatic Tool Co. 227
Clark Equipment Co., Construction Machinery Div. 62-63, 65
*Colorado Fuel & Iron Corp. 59, 154
*Colorado Iron Works, Sub. Mine & Smelter Supply Co. 168
*Columbia-Geneva Steel Div. 54-55, 130-131, 180-181
Columbian Steel Tank Co. 216
Crane Co. 189
*Crucible Steel Co. of America 34

Deister Machine Co. 218
*Denver Equipment Co. 115
DeZurik Shower Co. 223
Diamond Drill Contracting Co. 233
*Dings Magnetic Separator Co. 155
Dodge Manufacturing Corp. 188
Dorr-Oliver, Inc. 8-9
Dow Chemical Co. 31, 32-33
*duPont de Nemours & Co., E. I., (Explosives Dept.) 14

*Eagle Iron Works 208
Eddystone Div., Baldwin Lima-Hamilton Corp. 176
*Eimco Corp. 51, 53
*Elektrokemisk, A. S. 210
*Ensign-Bickford Co. 43
*Equipment Engineers, Inc. 166-167
Euclid Div., General Motors Corp. 145
*Falk Corp. 47, 171

Farbwerke Hoechst, A. G. 224
*Fate-Root-Heath Co. (Plymouth Locomotive Works Div.) 216
Flexible Steel Lacing Co. 198

*Galigher Co. 3
*Gardner-Denver Co. 56
General Electric Co. 16-17
General Electric Co., Locomotive & Car Equipment Dept. 138
General Electric Co., Construction Materials Div. 221
General Tire & Rubber Co. 121
Getman Bros. 225
Goodrich Industrial Products Co., B. F. 5
Goodyear Tire & Rubber Co. 13
Gould-National Batteries, Inc. 201
Greensburg Machine Co. 202

Hamilton Rubber Mfg. Corp. 129
*Hardinge Co. 132
*Harnischfeger Corp. 156-157
*Hazard Wire Rope Div., American Chain & Cable Co. 162
Hendrick Manufacturing Co. 225
*Hewitt-Robins 158
*Hoffman Bros. Drilling Co. 222

*Ingersoll-Rand 10-11
Industrial Brownhoist Corp. 148
*International Harvester Co. (Power) 18, 136-137
International Nickel Co. 50

*Jones & Laughlin Steel Corp. 159
*Joy Manufacturing Co. 64, 139, 183

*Kennametal Inc., Mining Tool Div. 190
*Kennedy-Van Saun Manufacturing & Engineering Corp. 124-125
Kenworth Motor Truck 37
*Kern Instruments, Inc. 39
Koehring Co. 48-49

Lainiere de Sclessin 207
*LeRoi Div., Westinghouse Air Brake Co. 152
*Le Tourneau-Westinghouse Co. 20-21, 22-23, 24-25, 27, 29
Leschen Wire Rope Div., H. K. Porter Co., Inc. 186
*Linatex Corp. of America 224
*Link-Belt Co. 19
Longyear Co., E. J. 57
Lukens Steel Co. 193

Mack Trucks, Inc. 205
Manitowoc Engineering Corp. 18D
Marion Power Shovel Co. 197
Mayo Tunnel & Mine Equipment 224
McLanahan & Stone Corp. 161
*Merrick Scale Mfg. Co. 212
*Mine & Smelter Supply Co. 147
*Mine Safety Appliances Co. 113
Minneapolis-Honeywell Regulator Co. 199
Mixing Equipment Co. 149

National Filter Media Corp. 170
*National Malleable & Steel Castings Co. 12
National Mine Service Co. 118
*Naylor Pipe Co. 58
New York Engineering Co. 218
Nitrogen Products, U. S. Steel 208
*Nordberg Manufacturing Co. 134-135
Northwest Engineering Co. 15

Ohio Brass Co. 169

Pennsylvania Drilling Co. 220
Pipe Linings, Inc. 222, 233
*Plymouth Locomotive Wks., Div. of The Fate-Root-Heath Co. 216
Porter Co., Inc., H. K. 186-187

Quaker Rubber Div., H. K. Porter Co., Inc. 187

*Riblet Tramway Co. 218
Ridge Tool Co. 232
Roebling's Sons Corp., John A. 41
Ryerson & Son, Inc., Joseph T. 109
Sanford-Day Iron Works 60-61
Sauerman Bros, Inc. 140
Schlueter Mfg. Co. 222
Searchlight Section 228-231
Sheffield Div., Armco Steel Corp. 185
Simplex Wire & Cable Corp. 46
*Smit & Co., Inc., Anton 216
*Smit & Sons, Inc., J. K. 163
Smith Engineering Works 26
Southwestern Engineering Co. 160
Spang & Co. 143
*Stearns Magnetic Products Div. of the Indiana Steel Products Co. 179
Sturtevant Mill Co. 209

*Tennessee Coal & Iron Div. 54-55, 130-131, 180-181
*Texas Co. 6-7
Texas Gulf Sulphur Co. 192
Thermoid Co. 195
Timken Roller Bearing Co. Fourth Cover
*Traylor Engineering & Mfg. Co. 44

United States Rubber Co. (Mech. Goods Div.) 107, 172-173
*United States Steel Corp. 54-55, 130-131, 180-181, 208
*United States Steel Export Co. 54-55, 130-131, 180-181
*United States Steel Supply Div. 180-181

*Victaulic Co. of America 146
*Vulcan Iron Works Co. 153

Walworth Co. 219
*Wedge-Wire Corp. 182
Western Gear Corp. 28
Western Machinery Co. 215
Western Precipitation Corp. 217
Wheel Trueing Tool Co. Third Cover
Wheelabrator Corp. 184
*Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp. 154
*Wilfley & Sons Co., A. R. 66
Willys Motors, Inc. 191

PROFESSIONAL SERVICES 226

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 228
EDUCATIONAL 230
BUSINESS OPPORTUNITIES 230
NOTICES
Auction 230
EQUIPMENT
(Used or Surplus New)
For Sale 229-231
WANTED
Equipment 230

ADVERTISERS INDEX

Canadian Metal Mining Associates 228
Carlyle Rubber Co. 231
Condor Mineral Exploration Co. 230
Foster Co., L. B. 231
Harris Machinery Co. 231
Heineken Inc., W. P. 230
Kral & Co., E. 230
Lefton Industrial Co. 231
Machinery Center, Inc. 229, 230
Morse Bros. Machinery Co. 231
National Lead Co., Titanium Div. 228
O'Neill, A. J. 230
Perry Equipment Corp. 230
Prospecting Commandments 230
Siler, Earl T. 231
Weisz Co., David 230

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Owner M. C. Winfield chose the CAT* D4 Tractor for this job because he liked its power. There's 50 drawbar HP in this machine, with a maximum drawbar pull of 10,700 pounds. There's sturdy quality built into every inch, from the long-life track pins and heavy-duty track rollers all the way into the rugged, dependable transmission. And Caterpillar's famed oil clutch, job-proven by thousands of hours of hard-working service, is available now on the D4. Other important features include an exclusive all-weather starting engine (it gets mighty cold up in this Colorado country!) and a fuel injection system that squeezes power from every drop of low-cost, non-premium fuel.

Your Caterpillar Dealer will be happy to demonstrate the D4—or any other of his big yellow machines—right out on your job. He's the man to call for expert service, too, and for replacement parts you can trust.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

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NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

DRILLING COSTS HIGH? *Read this—*

TRUCO CORING BIT

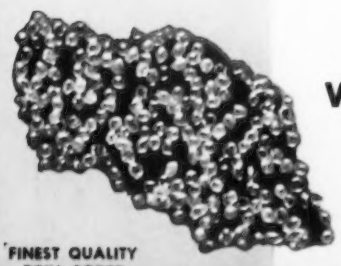
TRUCO CONCAVE BLAST HOLE BIT

TRUCO PILOT BIT

TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS

TRUCO STANDARD OIL FIELD BIT



FINEST QUALITY DRILL BORTZ

Cost per ton for drilling DOWN 66%

Cost per foot drilled DOWN 37.7%

Carats used DOWN 22.4%

Footage per bit UP 54%

Random purchase of diamond bits proved extremely costly in the early days of long blast hole drilling in limestone at The Warner Company's Bell Mine, Bellefonte, Pa. So, tests were conducted to provide data for bit performance analysis.

The analysis showed that the pilot type, non-coring bit delivered highest footage, highest diamond salvage and lowest cost per foot drilled. It also indicated the advantages of working with *one* manufacturer in developing a bit tailor-made to the job. The Truco bit was adopted and developed through progressive stages of improvement to the present level of performance which is remarkable by any standards.

One Truco bit had drilled 27,560 feet of hole when it was taken out of service to be studied. That footage is exceptional but footages of 10,000 to 12,000 feet per bit are not uncommon.

27,560 FEET WERE DRILLED *by this Truco bit before it was retired from service for study*

These studies have been continuous and cover type of bit, carats per bit, diamonds per carat, carats used per bit, salvage per bit, footage drilled per bit, bit cost, cost per foot drilled and cost per ton. They are, therefore, complete and factual and the information they yield has paid off. If you'd like to have a more detailed report of these studies, we'll be glad to send you a copy.

And, if drilling costs are your responsibility, maybe you should talk to the Truco Diamond Drill Bit man. Very likely he can help you.

Year	Footage Per Bit	Carats Used Per Foot Drilled	Salvage	Cost Per Foot Drilled	Cost Per Ton
1st	3630	.00089	67.7	0.0122	.0065
2nd	4930	.00085	68.1	0.0111	.0041
3rd	4300	.00084	69.6	0.0110	.0032
4th	5590	.00069	67.7	0.0076	.0022
	UP 54%	DOWN 22.4%		DOWN 37.7%	DOWN 66%

TRUCO DIAMOND BITS

by

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

WHEEL TRUEING TOOL CO. OF CANADA, LTD.
575 Langlois Avenue, Windsor, Ont., Canada

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DRILL BORTZ

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New TIMKEN® threaded carbide bit

Has 5 new features to lower your cost per foot-of-hole

5 front holes clear chips faster. Water shoots directly forward with more velocity against the face, washing chips to the rear faster. Center plug is dropped deeper for freer cutting action, less drag. New frontal design *cuts your cost per foot-of-hole.*

Deeper, wider clearance between the wings works with five front holes to speed chip removal. Extra clearance permits water to carry chips away faster from the cutting face. Faster chip flow speeds drilling, increases efficiency. You get *lower cost per foot-of-hole.*

Deeper undercut under the heel provides even freer passage for washed-back chips. It reduces bit drag, increases bit life. This new feature, plus redesigned heavier wing, helps speed your drilling, *lowers your cost per foot-of-hole.*

Wear-resistant carbides give the new Timken® bit longer life. These special analysis carbides resist wear better, provide added shock-resistance. They can be reconditioned many times. Bit gives longer service life, you get *lower cost per foot-of-hole.*

Improved thread contact reduces breakage. You get longer bit life, *lower cost per foot-of-hole.* Write today for free brochure. The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO".

THERE'S A TIMKEN BIT FOR EVERY JOB... EVERY DRILLING CONDITION

TIMKEN MULTI-USE BIT

With correct, controlled reconditioning, gives lowest cost per foot-of-hole when full increments of steel are used.

NEW TIMKEN TAPERED SOCKET BIT

For air-leg drills and light stoping. Removable for full steel life, tapered for more secure union. Same new frontal features as threaded bit.

TIMKEN ***REMOVABLE ROCK BITS***

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